NORTH ATLANTIC TREATY ORGANISATION

RESEARCH AND TECHNOLOGY ORGANISATION

AC/323(HFM-164)TP/429

www.rto.nato.int

RTO TECHNICAL REPORT **TR-HFM-164**

Psychological Aspects of Deployment and Health Behaviours

(Aspects psychologiques de la projection opérationnelle et comportements liés à la santé)

This Report documents the findings of Task Group 164, which investigated the role and impact of psychological factors, including the psychology of risk, upon the risky health behaviours of military personnel on deployments. This report also discusses the underlying mechanisms for such behaviours, as well as the need for health interventions, training and education, and future research.

Published May 2012

NORTH ATLANTIC TREATY ORGANISATION

RESEARCH AND TECHNOLOGY ORGANISATION

AC/323(HFM-164)TP/429

www.rto.nato.int

RTO TECHNICAL REPORT **TR-HFM-164**

Psychological Aspects of Deployment and Health Behaviours

(Aspects psychologiques de la projection opérationnelle et comportements liés à la santé)

This Report documents the findings of Task Group 164, which investigated the role and impact of psychological factors, including the psychology of risk, upon the risky health behaviours of military personnel on deployments. This report also discusses the underlying mechanisms for such behaviours, as well as the need for health interventions, training and education, and future research.

The Research and Technology Organisation (RTO) of NATO

RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote co-operative research and information exchange. The objective is to support the development and effective use of national defence research and technology and to meet the military needs of the Alliance, to maintain a technological lead, and to provide advice to NATO and national decision makers. The RTO performs its mission with the support of an extensive network of national experts. It also ensures effective co-ordination with other NATO bodies involved in R&T activities.

RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also co-ordinates RTO's co-operation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of co-operation.

The total spectrum of R&T activities is covered by the following 7 bodies:

- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS System Analysis and Studies Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These bodies are made up of national representatives as well as generally recognised 'world class' scientists. They also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

RTO builds upon earlier co-operation in defence research and technology as set-up under the Advisory Group for Aerospace Research and Development (AGARD) and the Defence Research Group (DRG). AGARD and the DRG share common roots in that they were both established at the initiative of Dr Theodore von Kármán, a leading aerospace scientist, who early on recognised the importance of scientific support for the Allied Armed Forces. RTO is capitalising on these common roots in order to provide the Alliance and the NATO nations with a strong scientific and technological basis that will guarantee a solid base for the future.

Published May 2012

ISBN 978-92-837-0161-3

Table of Contents

List of Figures/Tables

Terms of Reference

I. Origin

A. Background

Deployments can influence health-related behaviour (hence short-term and long-term health). Conversely, health-related behaviours can affect readiness and performance on deployed operations (hence operational effectiveness). The long deployment cycle and high operational tempo of NATO member nations put extra strain on readiness and effectiveness. Optimisation of health-related behaviours is therefore a potentially important force multiplier.

Despite the potential importance of health-related behaviours for military operations, surprisingly little scientific evidence exists with respect to:

- Which health-related behaviours most influence readiness and performance while deployed;
- Which health-related behaviours are influenced by deployment (and to what extent); and
- What roles do operational stressors and the psychology of risk play in the interaction between deployment and health-related behaviour.

The principal role of this RTG will be to assemble and summarize the existing and emerging research on these crucial issues.

B. Justification (Relevance for NATO)

A range of health behaviours are important for operational deployments. Those of increasing interest to the military include, inter alia, road traffic accidents (RTAs), vaccinations, disease and non-battle injuries (DNBI), exercise and sport participation, heat illness, and lifestyle behaviours (including food choice and eating behaviour, exercise, alcohol intake, smoking, and sexual health/behaviour).

The overarching objective of this work is to maximise the numbers of Servicemen and women who are 'fit for task' across the NATO militaries by identifying and disseminating scientific knowledge on which psychological constructs influence health compromising and health enhancing behaviours before, during, and after operational military deployments.

II. Objectives

A. Prioritize the impact of health-related behaviours on operational readiness in the context of increasing OPTEMPO.

B. Evaluate the effects of military operations on health related-behaviours across all phases of the deployment and explore novel strategies for their amelioration.

C. Examine the relationships between military relevant stressors and health-related behaviours that affect the performance of military personnel in the operational environment.

D. Identify the key covariates for health-related behaviours relative to deployment, with special attention to the psychology of risk.

III. Resources

A. Membership

Lead Nation: GBR

Participating Nations: CAN, EST, GBR, NLD, USA

Chair: Mr. Neil VERRALL United Kingdom

Co-Chair: Dr. Mark ZAMORSKI Canada

Lead Nation: United Kingdom

Nations and Bodies Really Participating: Canada, Czech Republic, Estonia, Netherlands, United Kingdom, United States

B. National and/or NATO Resources Needed:

C. RTA Resources Needed

Meeting facility for Kick Off meeting, at RTA HQ in Paris, in order to benefit from the expertise and guidance of the RTA staff on site.

IV. Security Classification Level

The security level will be Unclassified/Unlimited.

V. Participation by Partner Nations

PfP and MD invited.

See Membership.

VI. Liaison

COMEDS Health Care Working Group and Military Psychiatry Expert Panel.

HFM-164 Membership

Amanda M. KELLEY, PhD
Research Psychologist
Cognitive Assessment and Diagnostics Branch
US Army Aeromedical Research Laboratory
Building 6901
Fort Rucker, AL 36362
USA
Phone: +1 (334).255-6859
Fax: +1 (334).255-6993
amanda.m.kelley@us.army.mil

CDR RNLN Marten MEIJER, PhD
Associate Professor Netherlands Defence Academy
De la Reijweg 120 4818 BB Breda
PO Box 90002, 4800 PA Breda
NETHERLANDS
Phone: +31-76 5273204
Fax: +31-76 5273255
m.meijer.06@nlda.nl

CAPT Merle PARMAK, PhD
Research Psychologist
Applied Research Centre, Estonian National Defence College
Riia 12, 51013 Tartu
ESTONIA
Phone: +372 51 21 490
Fax: +372 717 6111
merle.parmak@mil.ee

Neil G. VERRALL, PhD
Principal Psychologist
Human Systems Group, Bldg 005, Room G02, i-SAT:E
Defence Science and Technology Laboratory
Porton, Wiltshire, SP4 0JQ
UNITED KINGDOM
Phone: +44(0)1980-65-8186
Fax: +44(0)1980-65-8400
ngverrall@dstl.gov.uk

Mark A. ZAMORSKI, MD, MHSA
Head, Deployment Health Section
Directorate of Mental Health
1745 Alta Vista Drive
Ottawa, ON K1A 0K6
CANADA
Phone: +1 (613) 945-6992
Fax: +1 (613) 945-6745
mark.zamorski@forces.gc.ca

Psychological Aspects of Deployment and Health Behaviours

(RTO-TR-HFM-164)

Executive Summary

Data from past conflicts and emerging data from the current conflicts in Southwest Asia suggest that deployments can also negatively impact health risk behaviours, such as tobacco use, high-risk drinking, and risky driving. These health behaviours are of course important determinants of health over the lifespan of the individual. The purpose of RTG-164 was to explore psychological aspects of deployment and health risk behaviours.

A preliminary list of 13 health risk behaviours was narrowed by rating each behaviour with respect to its impact on operational effectiveness, the strength of evidence showing an association with deployments, the potential relevance of the psychology of risk, and other factors. Tobacco use, high-risk drinking, and risky driving were identified as the three behaviours of greatest relevance. RTG-164 found strong evidence that these behaviours were influenced by at least some deployments, with the risk showing a consistent association with the extent of exposure to combat.

The most likely common mechanisms for the effect of deployment on health risk behaviours include:

1) Mediation by distress and mental disorders; and
2) Deployment-related changes in risk perception/risk tolerance.

RTG-164 made five specific recommendations for the mitigation of deployment-related health risk behaviours:

- Tobacco use, high-risk drinking, and risky driving should be the behaviours of greatest interest, given their public health impact and the strength of evidence suggesting a contributing role of deployments.
- Military organizations need to address these three high-priority health risk behaviours for the military population as a whole. That is, these are largely *public health problems* and not *deployment health problems*. Targeting the deployment population and the peri-deployment period for interventions may nevertheless be valuable, provided that it does not occur at the expense of efforts to mitigate these behaviours in the military population as a whole. Until such time as there is evidence that there are uniquely beneficial ways of targeting these health risk behaviours in the deployed population, prevention and control efforts should focus on those methods that have been shown to be most consistently effective in other contexts.
- Efforts to mitigate psychological distress and mental disorders are valuable in their own right, and these efforts will likely have benefits with respect to at least some health risk behaviours. However, the magnitude of these benefits will likely be small, so additional prevention and control efforts that specifically target the risk behaviours will be required.
- Until the relationships among deployment, risk perceptions, and health risk behaviours are clearer, it makes sense to follow the general sound principles of incorporation of risk-related messages in prevention and control efforts.
- Environmental interventions (as opposed to those that target the individual) are among the most consistently effective measures for the prevention and control of health risk behaviours. For this reason, military organizations should leverage the unusual degree of control that they have over the environment relative to other employers in their efforts to mitigate health risk behaviours.

Aspects psychologiques de la projection opérationnelle et comportements liés à la santé

(RTO-TR-HFM-164)

Synthèse

Les données provenant des conflits passés et les nouvelles données issues des conflits en cours en Asie du sud-ouest laissent à penser que les déploiements peuvent aussi avoir des conséquences négatives sur les comportements à risque pour la santé, tels que le tabagisme, la consommation excessive d'alcool et la conduite dangereuse. Ces comportements liés à la santé constituent bien entendu des facteurs déterminants pour la santé d'un individu durant toute sa vie. L'objectif du RTG-164 était d'étudier les aspects psychologiques d'un déploiement et les comportements à risque en matière de santé.

Une première liste composée de 13 comportements à risque pour la santé a été réduite en attribuant à chaque comportement une note en fonction de son impact sur l'efficacité opérationnelle, la qualité des preuves attestant un lien avec les déploiements, l'incidence potentielle de la psychologie du risque, et d'autres facteurs. Le tabagisme, la consommation excessive d'alcool et la conduite dangereuse ont été identifiés comme étant les trois comportements ayant la plus forte incidence. Le RTG-164 a découvert de solides preuves démontrant que l'impact sur ces comportements était dû à plusieurs déploiements, et que le risque était systématiquement associé au degré d'exposition au combat.

Les mécanismes communs les plus susceptibles d'avoir un effet lié au déploiement sur les comportements à risque en matière de santé incluent :

1) La médiation due à la détresse et aux troubles mentaux ; et
2) Les changements dus au déploiement en termes de perception du risque/tolérance du risque.

Le RTG-164 a formulé cinq recommandations spécifiques destinées à atténuer les comportements à risques en matière de santé et associés au déploiement :

- Le tabagisme, la consommation excessive d'alcool ainsi que la conduite dangereuse sont des comportements qui devraient être considérés avec le plus grand intérêt, étant donné leur impact sur la santé publique et la qualité des preuves suggérant qu'ils jouent un rôle important lors des déploiements.
- Les organisations militaires doivent accorder à ces trois comportements à risque pour la santé la plus grande priorité pour l'ensemble des personnels militaires. Le fait est qu'ils sont principalement des *problèmes de santé publique* et non des *problèmes de santé associés au déploiement*. Cibler ses interventions sur les populations soumises au déploiement et sur les périodes de péri-déploiement peuvent toutefois s'avérer utiles, à condition que cela ne se fasse pas au détriment des efforts d'atténuation de tels comportements pour l'ensemble des personnels militaires. Aussi longtemps qu'il soit prouvé qu'il existe des moyens uniques et efficaces de cibler ces comportements à risques au sein des personnels déployés, les mesures de prévention et les efforts en matière de contrôle devront se concentrer sur ces méthodes qui se sont toujours révélées efficaces dans d'autres contextes.
- Les efforts mis en œuvre pour atténuer la détresse psychologique et les troubles mentaux ont toute leur utilité à part entière, et ceux-ci seront probablement bénéfiques au moins à certains comportements à risque liés à la santé. Cependant, l'importance de ces bénéfices sera probablement

moindre, et des mesures supplémentaires de prévention et d'efforts de contrôle destinées à cibler de manière spécifique les comportements à risque s'avèreront nécessaires.

- En attendant que la relation entre déploiement, perception du risque et comportements à risque pour la santé devienne évidente, il apparaît judicieux de suivre les raisonnables principes généraux relatifs à l'intégration de messages associés aux risques dans les actions de prévention et les efforts de contrôle.
- Les interventions au niveau du contexte environnemental (par opposition à celles qui ciblent l'individu) figurent parmi les mesures efficaces les plus cohérentes en matière de prévention et de contrôle des comportements à risque liés à la santé. Pour cette raison, les organisations militaires devront exercer un niveau de contrôle hors du commun sur l'environnement en lien avec d'autres employeurs dans les efforts d'atténuation des comportements à risque pour la santé.

Chapter 1 – INTRODUCTION

by

Neil VERRALL, PhD (GBR) and Mark ZAMORSKI, MHSA (CAN)

1.1 THE IMPORTANCE OF HEALTH RISK BEHAVIOURS IN MILITARY ORGANIZATIONS

How people behave powerfully influences their health [1]. Health risk behaviours are those actions that result in a higher risk of adverse health consequences, such as impaired well-being, burdensome symptoms, diagnosable diseases, and functional impairments. Both short-term consequences (e.g., death from a road traffic accident related to risky driving) and long-term consequences (e.g., lung cancer from smoking tobacco) are possible, and both are relevant to the individual and to their employer.

In military organizations, health problems related to health risk behaviours can pose threats to readiness, operational effectiveness, and force sustainability [2]. Health behaviours influence the use of health services (accounting for up to 25% of health care costs), and these are usually provided by or paid for by military organizations. As is true in the general population, military health care costs are growing at rates that significantly exceed inflation [3]. For these reasons alone, health risk behaviours are of interest to the military.

In addition, some aspects of military service, notably operational deployments, can adversely affect health risk behaviours, including tobacco use, risky drinking, and risky driving behaviour. The latter has been associated with an increased risk of death from road traffic accidents after return from deployment [4]. Thus, the military has a special obligation to do what it can to understand and mitigate this potential adverse effect of military service.

This brief introductory chapter will provide an overview of health risk behaviours in military organizations, focusing on:

- The effect of health risk behaviours upon health;
- The prevalence of health risk behaviours in military organizations;
- The effect of the health of military personnel upon readiness, operational effectiveness, and force sustainability;
- The effects of military deployments upon health and health risk behaviours; and
- The potential centrality of the psychology of risk to deployment-related health risk behaviours in military organizations.

1.2 THE EFFECT OF HEALTH RISK BEHAVIOURS UPON HEALTH

The influence of certain health risk behaviours on health is powerful. The most important health risk behaviours for developed countries include tobacco use, risky drinking, and risky driving behaviour [1];[5]. These behaviours affect the health of others in addition to the person engaging in the behaviour (e.g., second-hand smoke, death or injuries to others due to drink driving or speeding). The impacts of these behaviours on health status are briefly summarized below.

1.2.1 Tobacco Use

Tobacco has widespread negative effects on health, contributing heavily to morbidity and mortality from a broad range of illness, including cancer (including the lung, oral cavity and throat, oesophagus, and bladder),

cardiovascular disease, and chronic obstructive pulmonary disease. The specific risks depend on the mode of administration (smoking, chewing, snuff, etc.) and the amount and duration of use, but as a whole, tobacco accounts for the largest single fraction of years of potential life lost among health risk behaviours in high-income countries [1]. Public health effects of second-hand smoke are also significant, with about a tenth of all tobacco-related deaths being attributed to second-hand smoke [1].

1.2.2 Risky Drinking

Most people who drink do so because they enjoy it, finding that it adds to the value of their social interactions. Moderate alcohol consumption also has benefits in terms of cardiovascular disease. However, drinking above certain limits (either per week or on a single occasion) is associated with a broad range of adverse health outcomes, including increased morbidity and morality from injuries, suicide, psychosocial distress due to alcohol use disorders, liver disease, and certain cancers. In high-income countries, alcohol use is second only to smoking among purely behavioural risk factors in its effects on the overall burden of disease [1]. As with smoking, one person's drinking can affect the health of others, notably in the realm of alcohol-related road traffic accidents.

1.2.3 Risky Driving

Nearly all Road Traffic Accidents (RTAs) have a behavioural contribution: Drinking and driving, speeding, driving while sleep-deprived, failure to wear seatbelts or motorcycle helmets, driving under adverse weather conditions, and many other factors have been shown to increase the risk of accidents and related injuries and deaths [6]. RTA-related injuries are leading causes of death in the demographic group that forms the bulk of the military population, namely younger men. And again, one person's driving behaviour can affect the health of others.

1.3 THE PREVALENCE OF HEALTH RISK BEHAVIOURS IN MILITARY ORGANIZATIONS

The overall public health impact of a health risk behaviour depends on four key factors:

- The prevalence of the behaviour: The higher the fraction of the population that engages in a health risk behaviour, the greater its potential impact.
- The frequency/intensity of the behaviour: For example, smoking more cigarettes, smoking more frequently, and smoking for longer periods of time increase the risk for smoking-related health problems.
- The relative risk of adverse health outcomes occasioned by the behaviour: For example, the risk of a fatal road traffic accident increases dramatically in intoxicated drivers, whereas the risk of heart disease increases only modestly in smokers.
- The overall severity of the behaviour-related health outcomes.

1.3.1 Tobacco Use

The prevalence of tobacco use varies substantially from Nation to Nation, but all NATO Nations have substantial prevalence rates of tobacco use: Between a quarter and a half of the adult population are current users. As discussed in detail in a later chapter, tobacco use tends to be at least as prevalent in military personnel as in the source population.

1.3.2 High-Risk Drinking

Alcohol consumption and alcohol use patterns also vary from Nation to Nation, but again all NATO Nations have substantial prevalence rates of high-risk drinking. Weekly episodic heavy drinking (only one

pattern of high-risk drinking), for example, is reported by more than 10% of European adults. Rates tend to be higher in younger males, who of course for the bulk of the military population. In some Nations (notably the UK), rates among military personnel are higher than their general population counterparts.

1.3.3 Risky Driving

Risky driving behaviour is harder to quantify because it comprises a broad range of diverse behaviours. The most comparable statistics refer to seat belt use: In Europe, 24% of those seated in the front and 54% of those seated in the rear use seat belts [7]. Surveys indicate that a substantial fraction of adults report having driven after having had too much to drink. The high rates of arrests for drunk driving and the high rate of alcohol-related accidents also speak to the high prevalence of drinking and driving. Drinking and driving is particularly prevalent among younger men, who again form the bulk of the military population.

1.4 THE EFFECT OF THE HEALTH OF MILITARY PERSONNEL UPON READINESS, OPERATIONAL EFFECTIVENESS, AND FORCE SUSTAINABILITY

Health is a vital component of operational readiness and capability because it enables fighting forces to be "fit for purpose". NATO's modern military forces are increasingly streamlining their overall manpower in order to deploy them in an agile and rapid manner. Additionally, the nature and range of modern military deployments vary in terms of their context and remit (e.g., warfighting, peace support, peacekeeping and humanitarian relief operations). Furthermore, current operational tempo is taking its toll on available manpower, which affects retention figures and available manpower figures in those contributing forces [8]. Therefore, the remaining manpower must be maximised and fit for purpose. Thus, reductions in overall health due to a myriad of health-related factors will affect the overall sustainability of a force, which will ultimately affect its overall capability and effectiveness.

Operational health is essential to military personnel as it is a key enabler for human performance, which ultimately influences military capability, military performance, and operational effectiveness. This requirement is due in part to the future global security challenges facing NATO, and the need for flexible and adaptable Armed Forces to carry out expeditionary operations. The long-term and continued transformation of NATO Forces is to deliver a NATO Network-Enabled Capability (NEC) in order to produce strategic effects, which can only occur through the capability of people, thus requiring the appropriate levels of health.

Health risk behaviours are also important drivers of health care expenditures, which are of obvious interest to military and veterans' organizations. As these escalate at rates that exceed overall cost inflation, resources that could be dedicated to recruitment, training, and equipment instead gets directed towards the delivery of health care. The US Secretary of Defense, Robert Gates, recently noted that the current rate of increase in military health care expenditures is "unsustainable" [3]. Health problems thus represent a double threat to force sustainability: They deplete the fighting force through medical attrition and they limit its capacities by constraining the availability of resources for those who remain.

1.5 THE INFLUENCE OF DEPLOYMENTS UPON HEALTH AND HEALTH BEHAVIOURS

It is known from years of research that military deployments produce effects upon physical, mental, and psychological health. These effects have been found in deployments that are both benign and intensive, and have been found across the spectrum of operational activity, i.e., warfighting, peace enforcement, peacekeeping and humanitarian relief. This suggests that military deployments, irrespective of location, intensity and remit, affect health-related issues, whether it is subjective perceptions or objective measures of health and health behaviours [2].

1.6 THE CENTRALITY OF THE PSYCHOLOGY OF RISK TO HEALTH RISK BEHAVIOURS IN MILITARY ORGANIZATIONS

There is one key psychological construct that is deeply embedded within military careers and military deployments…Risk. The construct of risk is assumed to be an important aspect of the military domain. The necessity to embrace risk can be viewed as the military's raison d'être. This can be summed up by the former head of the British Army, who stated that "soldiering is not a risk free business; it never can be"[1]. In addition to this, formal doctrine acknowledges the part that risk plays in the military domain:

> "Importantly, by its very nature, military activity is about confronting risk and managing it. It is emphatically never about avoiding risk; the military profession is not one for those who are risk averse." [9]

Risk is not just confined to health-related issues but is important throughout military activities, for example, leadership approaches to risk taking, strategic decision making at the operational level, and rapid decision making at the tactical level. Individual and group risk perception (and management) therefore involves assessment of the operational location, environment, and a plethora of contextual factors. Therefore, it can be seen that risk plays a central role in military performance, and as such, is a complex phenomena that can help to understand and explain behavioural, organisational and cultural indices in unique settings.

How individuals evaluate risks obviously has an influence on their decision to engage in health and other risk behaviours. While each behaviour has its own considerations when it comes to the way people evaluate the risks and benefits of engaging in it at a particular place and time, there are commonalities the individuals apply across behaviours. Strong evidence for this comes in the form of the observation that risk behaviours of all sorts are correlated with one another and share identifiable substrates in human psychology.

To the extent that the decision to engage in armed combat at great personal risk is largely a voluntary one in most NATO Nations, it is plausible that the psychological factors that underlie that decision may have also have an influence on the decision to engage in other risk behaviours, notably health risk behaviours. Finally, armed combat is a life altering experience that has the capacity to dramatically and permanently change one's worldview [10]. As such, it could have a plausible effect on psychological factors that facilitate (or inhibit) risk-taking behaviour.

1.7 PREVENTING AND CHANGING HEALTH RISK BEHAVIOURS

Individuals can modify their health risk behaviour on their own or in response to individual or environmental interventions. Preventing or changing health risk behaviours can be difficult. After all, people behave as they do because their behaviours meet certain needs and fit into their lives. That understood, a broad range of interventions at the level of the individual have been shown to facilitate changes in health behaviour. For example, taking certain medications facilitates smoking cessation, as does participation in formal smoking cessation programs. Even simple, brief advice from a physician can have a small but measurable influence on smoking cessation.

Health professionals tend to think of interventions applied to individual patients when they think of prevention or reduction of health risk behaviours. But environmental interventions are often far more effective: There is strong evidence that tobacco policy (taxes, availability, enforcement, etc.) has a powerful influence on tobacco use behaviour. Drink driving laws (and their aggressive enforcement) decrease alcohol-related traffic fatalities.

[1] General (retired) Sir Mike Jackson. BBC1 Remembrance Sunday: the Cenotaph, Sunday 11th November 2006.

Optimally effective health promotion efforts are facilitated by a rich understanding of the full range of factors (individual, social, and environmental) that drive health-related behaviours. Military organizations can offer services and educational programming to individuals that mitigate health risk behaviours. In addition, though, military organizations can take advantage of their unusual degree of control over the environment; this far exceeds that of a typical employer. For example, tobacco and alcohol are often sold in military commissaries and messes; the pricing and availability of these can have an effect on their use. Military personnel undergo mandatory periodic health evaluations by clinicians who are themselves employees of the organization, hence in a position to advance the organizations' health risk behaviour mitigation objectives. The military has its own newspapers, radio stations, and even television stations that can be used for public service announcements on health risk behaviours. Military police patrol military communities and hence are in a position to aggressively enforce traffic laws, including those surrounding drink driving. Thus, military organizations have an enviable degree of control over the environment and an enviable ability to coordinate individual and environmental interventions across the organization.

1.8 CONCLUSION

All of these efforts to effectively mitigate health risk behaviours hinge upon having a rich understanding which behaviours individuals engage in, which groups are at particular risk, and the factors that facilitate their initiation and persistence. Many of these factors have their substrate in the *psychology* of military personnel and their *physical and social environment*, to which the military contributes heavily. Thus, knowledge of military specific aspects of health risk behaviours (including their relationship to deployment) is essential for the development of effective policies, programs, and services.

The remainder of this report will first summarize the methods used in RTG's approach to identifying and prioritizing health risk behaviours for its work. It will then review data on tobacco use, risky drinking, and risky driving in military organizations, focusing in particular on the evidence of an association with deployments. Possible mechanisms by which deployment could affect each of these will be discussed. The conclusion will attempt to answer the important question: "How is it that deployment has a consistent deleterious effect on health risk behaviours?" Two possible explanations will be explored in depth, specifically mediation by distress or mental disorders or by changes in risk psychology related to the deployment. Finally, recommendations for research and public health practice will be offered.

1.9 REFERENCES

[1] Lopez, A.D., Mathers, C.D., Ezzati, M., Jamison, D.T. and Murray, C.J. Global Burden of Disease and Risk Factors. New York: The World Bank and Oxford University Press; 2006.

[2] Institute of Medicine. Protecting Those Who Serve: Strategies to Protect the Health of Deployed U.S. Forces. Washington, DC: National Academy Press; 2000.

[3] Bumiller, E. and Shanker, T. Gates seeking to contain military health costs. New York Times 2010 November 28.

[4] Gray, G.C. and Kang, H.K. Healthcare utilization and mortality among veterans of the Gulf War. Philos Trans R Soc Lond B Biol Sci 2006 April 29; 361(1468):553-69.

[5] Murray, C.J. and Lopez, A.D. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. Lancet 1997 May 17; 349(9063):1436-42.

[6] World report on road traffic injury prevention. Geneva: World Health Organization; 2004.

[7] European Transport Safety Council. Seat belt use: Why increase enforcement? European Transport Safety Council Web Site 2010 June 6.

[8] Rona, R.J., Fear, N.T., Hull, L., Greenberg, N., Earnshaw, M. and Hotopf, M. et al. Mental health consequences of overstretch in the UK armed forces: first phase of a cohort study. BMJ 2007 September 22; 335(7620):603.

[9] Ministry of Defence (UK). British Defence Doctrine. London: Ministry of Defence (UK); 2001.

[10] Tedeschi, R.G. and McNally, R.J., Can we facilitate posttraumatic growth in combat veterans? Am Psychol 2011 January; 66(1):19-24.

Chapter 2 – METHODS

by

Amanda KELLEY, PhD

ABSTRACT

Not all health behaviours are equally prevalent, impactful, or controllable. For this reason, comprehensive health promotion and disease control efforts that target health risk behaviours need to begin with a careful assessment of their public health priority. RTG-164 identified a list of 13 health risk behaviours of potential interest and then rated these against ten explicitly-weighted criteria. The impact of the behaviour on operational effectiveness, the strength of evidence of an association with deployment, and the relevance of the psychology of risk were the most heavily-weighted criteria, based on public health considerations and RTG-164's Terms of Reference. Three behaviours were identified as being the highest priority: Tobacco use, risky alcohol use, and risky driving behaviours. Sleep/rest behaviours (for the management of fatigue) and suicidal behaviours were judged to be important, but extensive work in these areas by NATO and other groups made these a lower priority for RTG-164.

2.1 IDENTIFICATION OF HEALTH RISK BEHAVIOURS FOR RTG-164'S WORK

The RTG's first substantive task was to identify a limited number of behaviours to explore in depth. We recognized that the number of potential health-related behaviours to consider was large, and, our group being a small one, we had limited resources to commit to the work. We believed *a priori* that it was likely that some behaviours would be far more important than others.

2.2 LIST OF POTENTIAL HEALTH RISK BEHAVIOURS

The RTG began this task by brainstorming a long list of potential health behaviours:

- Tobacco use;
- Risky alcohol use;
- Risky driving behaviours;
- Sleep/rest behaviours (for management of fatigue);
- Risky behaviours other than those related to motor vehicles (e.g., falls);
- Stimulant use;
- Hygiene (e.g., hand-washing);
- Exercise;
- Malaria prevention/arthropod protection behaviours;
- Immunization uptake;
- Risky sexual behaviour;
- Risky eating habits; and
- Use of illicit drugs.

Suicide was discussed as a health risk behaviour of potential interest, but the RTG chose not to look into it further given the activities of another NATO HFM RTG on this topic.

2.3 PRIORITIZATION OF HEALTH RISK BEHAVIOURS

This list was judged by the RTG to be too long to tackle given its limited membership. In addition, many behaviours on the preliminary list consisted of a series of complex behaviours. For example, malaria prevention could consist of taking prophylactic medication, applying repellent, using bed nets, etc. Each of these could raise very different issues. For these reasons, the RTG identified a list of considerations that it would use to identify a more limited number of health risk behaviours of highest priority for its attention. Some of these considerations were judged to be more important than others for the RTG's purposes. The considerations identified are described in the sub-sections below, followed by the RTG's ranking of their relative importance.

2.3.1 Strongest Considerations

2.3.1.1 Impact on Operational Effectiveness

The direct impact of the behaviour on operational effectiveness is an essential consideration. Indeed, it is generally the most important consideration for military organizations. The RTG understood threats to readiness to deploy (e.g., from behaviour-related health problems) as having an impact on operational effectiveness. The impact on operations effectiveness considered here were more direct ones (e.g., incapacitation with malaria while deployed) over a short time horizon.

2.3.1.2 Strength of Existing Evidence of a Relationship to Operational Deployments

Many of the health risk behaviours of potential interest have no known relationship to operational deployments while others have good evidence of at least a statistical association. The RTG judged that it made the most sense to focus on those health risk behaviours for which there was the best evidence of an association.

2.3.1.3 Relevance of the Psychology of Risk to the Health Risk Behaviour

The central role of the psychology of risk in is highlighted in the Terms of Reference of RTG-164, hence it was judged to be an important factor. In addition, it was a factor that was judged to have potentially broader applicability to health risk behaviours other than those upon which the RTG chose to focus.

2.3.2 Intermediate Considerations

2.3.2.1 Overall Public Health Impact

The overall impact on public health was meant to capture the strength of the effect of the behaviour on diseases and injuries and the severity of those consequences in terms of functioning.

2.3.2.2 Impact on Individual Well-Being

Some health behaviours (or their consequences, such as obesity) also have an effect on well-being independent of diagnosable illnesses or injuries. This factor was meant to capture such impacts.

2.3.2.3 Impact on Non-operational Effectiveness

The direct and indirect impact of health behaviours on work performance in the non-deployed environment is also an important consideration. It was judged to a less important consideration than operational effectiveness.

2.3.2.4 Ability to Influence the Behaviour at the Individual Level

Focusing on health risk behaviours makes sense mainly if there is something that can be done to prevent or change them. Individuals can modify their health risk behaviour on their own or in response to individual or environmental interventions. Individual-level interventions can also act to prevent the initial acquisition of health risk behaviour (e.g., smoking). When the target behaviour cannot be changed immediately, harm reduction strategies (e.g., needle exchange programs for injection drug users) may be effective at mitigating the adverse health impact of some behaviours.

2.3.2.5 Ability to Influence the Behaviour at the Environmental Level

Environmental interventions are of particular interest to military organizations because they can control many aspects of their member's environment. For example, the US Marine Corps prohibits tobacco use during basic training. Military organizations can influence what their members eat, when they sleep, how much they pay for alcohol, where they can and can't go, etc.

2.3.3 Weaker Considerations

2.3.3.1 Out-of-Pocket Cost to the Individual

Some health risk behaviours are expensive and hence can have a negative effect on family finances. Smoking is of course a relevant example. The RTG wanted to capture these effects as a consideration in prioritizing health risk behaviours, but this was judged to be a weaker consideration.

2.3.3.2 Impact on Overall Long-Term Health Care Costs

Health care costs are of interest to military organizations. However, most serious behaviour-related illnesses (such as smoking-related cancer and heart disease) tend to affect people largely after they have left military service. The health care costs associated with these illnesses are however typically borne by society as a whole, hence should be of at least some interest to military organizations.

2.4 RESULTS OF PRIORITIZATION

The RTG consulted standard public health resources and the deployment health literature to rate each health risk behaviour (or group of behaviours, e.g., risky driving behaviours) with respect to each consideration detailed above.

As detailed in Table 2-1, four potential behaviours appeared to be most worthy of the attention of the group:

- Risky drinking;
- Tobacco use;
- Risky driving; and
- Sleep/rest behaviours (for management of fatigue).

Table 2-1: Risk Behaviour Prioritization Matrix.

	Stronger Factors to Consider for this RTG [a]			Intermediate Factors					Weaker Factors		
Behaviour	**Operational Effectiveness Impact**	**Evidence of Relationship to Deployment [b]**	**Relevance to Psychology of Risk [c]**	**Public Health Impact [d]**	**Well-Being Impact**	**Non-Operational Effectiveness Impact**	**Ability to Influence: Personal Level [e]**	**Ability to Influence: Environmental Level [f]**	**Cost to Individual (Out of Pocket) [g]**	**Impact on Health Care Costs [h]**	**Overall Priority**
Tobacco Use	Low	High	Possible	High	Mixed [i]	Low	Moderate to High [j]	High	High	Mixed	**High**
Alcohol Consumption	Varies [k]	High	Possible	High [l]	Mixed [m]	Moderate	Moderate	High	High	High	**High**
Risky Driving	Low [n]	High	Possible	High	Low [o]	Low	? [p]	High	Moderate	Low to Moderate?	**High**
Sleep/Rest (Fatigue Management)	High [q]	High [r]	Low	Low to Moderate [s]	Moderate	Moderate	Moderate to High [t]	High	Low	Low to Moderate	**Moderate to High [v]**
Safety (Other than motor vehicle – e.g., falls – to includes sports)	Moderate – High [w]	Moderate (On deployment); Afterwards = ?	Possible	Moderate	Mixed [x]	Moderate to High	Low?	High	Low [y]	High	**Moderate [z]**
Stimulant Use	Potentially High	Potentially High	Possible	Low to Moderate	Mixed	Moderate	High	High	Low	Low to Moderate	**Moderate [aa]**
Hygiene	Moderate	High	Possible	Low	Low to Moderate	Low	?	Moderate	Low	Low	**Low to Moderate**
Exercise	Mixed [bb]	Mixed	Possible	Low to Moderate	Mixed [cc]	Mixed	Low	High	Low to Moderate (Varies by activity)	Mixed	**Low to Moderate**
Malaria/Arthropod Protection	Varies, but can be substantial	Varies, but can be substantial	Possible	Low	Low	Low	?	High	Low	Low	**Low to High [dd]**

	Stronger Factors to Consider for this RTG [a]			Intermediate Factors					Weaker Factors		
Behaviour	**Operational Effectiveness Impact**	**Evidence of Relationship to Deployment [b]**	**Relevance to Psychology of Risk [c]**	**Public Health Impact [d]**	**Well-Being Impact**	**Non-Operational Effectiveness Impact**	**Ability to Influence: Personal Level [e]**	**Ability to Influence: Environmental Level [f]**	**Cost to Individual (Out of Pocket) [g]**	**Impact on Health Care Costs [h]**	**Overall Priority**
Immunization Uptake	Low, but catastrophes [ee] are possible	High because tied to deployment	Possible	Low, but catastrophes are possible	Low	Low	Moderate	High	Low	Low	**Low**
Risky Sexual Behaviour	Low	High (evidence that sexual activity is different while deployed)	Possible	Low [ff]	Mixed	Low	Moderate	?	Low	Moderate	**Low**
Eating Habits	Low	Moderate (may be different on deployment)	Low	Moderate	Mixed	Low	Low	Moderate	Mixed	Moderate	**Low**
Use of Illicit Drugs	Generally Low [gg]	Moderate with Vietnam – low otherwise	Possible	Low to Moderate	High	Moderate	Low	Moderate	Moderate to High	Moderate	**Low**

Notes for Table 2-1

[a] We identified these factors as being the most important to consider because they are directly tied to the Technical Activity Proposal we submitted. We judged operational effectiveness to be a more urgent concern than the overall public health impact because the latter may occur long after separation from service.

[b] This includes evidence that the deployment cycle influences the behaviour as well as evidence that the behaviour has special significance while deployed (e.g., malaria precautions).

Notes for Table 2-1 (cont'd)

[c] This factor was evaluated on largely theoretical grounds, and it proved to not distinguish much among the behaviours.

[d] For high income countries.

[e] Individual-level interventions means those designed to influence the behaviour of the individual through education, persuasion, or intervention. This would include things such as educational programming, brief advice from a physician, one-on-one counselling, medications, etc.

[f] Environmental interventions are often more effective than individual interventions to change health-related behaviour (or its consequences). For example, changes in laws and enforcement of drink driving laws have lessened the number of alcohol-related accidents. Similarly, mandatory airbags have decreased the fatality rate for those accidents that do occur. The price of alcohol and tobacco (which are in part related to regulations) do influence the level of consumption.

[g] Relative to other health risk behaviours.

[h] The cost to the health care system is an important consideration, particularly given that the military generally pays for its own health care costs and given that other governmental agencies may pay for health care costs for veterans. We downplayed this as a factor for several reasons: First, rigorous research into it would be required, and no one in the group has the expertise to critically appraise the relevant methodologies used. Second, costs (health care and otherwise) have a complicated relationship with health behaviours because they may actually save money by resulting in premature death from acute illnesses, obviating the costs for chronic care at the end of life. Finally, we felt that these would be captured to some extent by the public health impact.

[i] Smokers do report well-being benefits.

[j] There is evidence for individual-level interventions such as smoking cessation programs, taking medications to help with quitting, etc. But the fraction of people using these is relatively small (though growing) and the success rate per quit attempt is relatively low (though growing).

[k] Varies depending on access to alcohol and policies surrounding its use.

[l] Moderate drinking is associated with health benefits in terms of a lower risk of cardiovascular disease. But these are overshadowed by negative health effects of alcohol, particularly for heavy drinkers.

[m] For most high-risk drinkers (those without an overt alcohol use disorder), drinking improves well-being.

[n] Transport accidents are an important cause of non-battle death/injury. It is difficult to assess what fraction of these is due to risky driving as opposed to other factors. We judged the impact to be low because the number of individuals involved is low relative to other threats to operational effectiveness.

[o] Well-being impact is low overall because the number of affected individual is low, in relative terms.

[p] With the exception of legal proscriptions against driving for dangerous drivers, the RTG was unfamiliar with any individual-level interventions that directly influence risky driving behaviour.

[q] Particularly in war-fighting.

[r] Self-reported sleep problems and fatigue are commonly reported problems on deployment, and there is a demonstrable effect of fatigue and sleep deprivation on performance.

[s] Fatigue/sleepiness is a major contributor to motor vehicle accidents, being second behind second only to alcohol as a contributory factor in crashes resulting fatalities or serious injuries.

[t] High for stimulants and hypnotics (because people are likely to take them if they are prescribed to them, assuming they are effective and well-tolerated). Low for sleep-related behaviours on deployment because this is more dependent on environmental factors than on individual choices. Low to moderate for sleep problems in garrison (there is evidence that cognitive behavioural strategies are effective for primary sleep disorders); effective therapy for mental health problems effectively restores sleep when due to mental health problems.

[u] In theory, sleep and rest can be modified through environmental interventions. For example, situating sleeping areas away from noisy areas (e.g., heliports, runways) is possible in theory, but in practice it is very difficult because of other overriding considerations such as security.

[v] While this is an overall moderate to high priority, we elected not to include it in our work for several reasons: First, the stimulant issue is likely to be addressed by another NATO group dealing with advanced technologies for performance enhancement. Second, a previous NATO group dealt with fatigue management, and there are already many publications on that topic. Finally, it did not fit n conceptually with the other behaviours we are targeting.

[w] Injuries (many sports-related) are an important cause of lost time on deployments, as well as repatriations.

[x] Physical activity is associated with enhanced well-being for most people, but it is a major contributor to injuries, which can impair well-being.

[y] Some sports are expensive, but most are not.

[z] Physical fitness issues are covered by another RTG. Other safety-related behaviours are multiple and public health threat is less than for driving.

[aa] We dealt with this separately in this table but later decided to collapse it into the topic on sleep/rest/fatigue management because it is just a potential strategy to address fatigue/ sleepiness.

[bb] Physical activity has a complex relationship with readiness: It enhanced fitness (promoting readiness) while at the same time it is a major risk factor for injuries.

[cc] Physical activity is associated with enhanced well-being for most people, but it is a major contributor to injuries, which can impair well-being.

[dd] This depends on the nature of the operation. For operations in hyperendemic areas, the priority is very high as the attack rate without protection is as high as 50% over a few weeks; this can completely paralyze an operation. As it happens, the bulk of those deployed on current operations for the Nations that are part of this group are to areas with relatively low risk. For this reasons, we accorded it low priority.

[ee] The only vaccine for which this has been a big issue is the anthrax vaccine because it has been optional at times. The impact is hard to judge because the probability of a major anthrax attack is presumably very small (but impossible to quantify) and the effectiveness of the vaccine in such circumstances is also uncertain.

[ff] While sexually transmitted infections are relatively common, their public health impact is relatively low in high-income countries.

[gg] This depends on the conflict in question.

The RTG elected to drop sleep/rest behaviours because there has already been extensive work in this area, and other NATO groups are actively working in this area. Some behaviours that had initially attracted our interest did not advance into the top tier in our ranking. For example, we though that risky sexual behaviour would emerge as an important issue, but it didn't, largely because the risk of sexually transmitted infections is low in absolute terms and because most have relatively little impact on operational effectiveness. Malaria prophylaxis and arthropod precautions are crucial in some deployments but are less important in the current operations in Southwest Asia, so these were not considered further.

The RTG recognizes that many of its rankings/ratings are open to question, although informal sensitivity analysis of the priority accorded to the different considerations discussed above did not meaningfully change the conclusion. Additional time and effort in this preliminary step certainly would have enhanced its scientific rigor. But doing so would have interfered with the actual work of the RTG, namely the review of the literature on the association of deployment with health behaviours and the execution of research projects in this important area.

2.5 LITERATURE SEARCH STRATEGY

Having settled on the three key health behaviours of interest, literature searches were completed in US Defense Technology Information Center (DTIC), PubMed/Medline, and PsycInfo between June 2008

and January 2009. Further searches for unpublished studies were carried out by hand searching technical reports and contacting colleagues in the research area of interest. The primary keywords used to search are displayed in Table 2-2. Additional terms not immediately related to the three health behaviours of primary interest were included for validation purposes.

Table 2-2: Literature Search Keywords.

Categories	**Keywords**
Psychology of Risk	Sensation Seeking
	Impulsivity
	Risk Propensity
	Risk Taking
Health Behaviours	Smoking, Tobacco, Nicotine
	Health Behaviours, Addiction, Substance Abuse
	Risky Driving
	Alcohol
Military Operations/Deployment	Sleep Deprivation
	Fatigue
	Heat Stress
	Combat Stress/Combat Experiences
	Readiness, Duty
	Deployment Stress

Chapter 3 – ADVERSE EFFECTS OF TOBACCO USE IN DEPLOYED MILITARY UNITS

by

Merle PARMAK, PhD (EST) and Marten MEIJER, PhD (NLD)

ABSTRACT

Although research reveals that smoking prevalence has in general stabilized or is even decreasing among military personnel, this trend does not ultimately apply. Being young, being deployed, or being a member of Army personnel, for instance, is proven to increase the risk of being or beginning to be a tobacco user. Usually there are not immediate links emphasised between tobacco habits and the serious health-related consequences during the service period because of the long time lag between tobacco use and its consequences. With some exceptions, the impact of smoking on military performance is defined rather indirectly than directly. However, findings in the Estonian military sample (n = 135) indicate that an increase in smoking behaviour while on deployment not only corresponds with poorer psychological well-being and general health, but also with being forced to stay away from duty because of physical aches. These results can be taken as indicators that smoking behaviour decreases fitness for military operations and should be targeted by performance enhancement activities. The role of the military culture of smoking behaviour and the arguments for an effective strategy for tobacco use cessation among military personnel are discussed.

3.1 TRENDS IN TOBACCO USE

Considering the direct and indirect costs related to consequences of tobacco habits, high importance has been attributed to this behaviour in health policies. Tobacco use is known as the single largest cause of preventable death in the world today, killing a third to a half of all users. Projecting into the future, the total tobacco-attributable deaths will account for almost 10% of all deaths worldwide in 2030 [1] In the WHO European Region, smoking is blamed for about 18.6 million years of life lost [2].

The financial costs caused by tobacco-related illnesses and medical care are remarkable. The direct and indirect costs of smoking in the EU, for instance, were estimated to range from 1.04% to 1.39% of the EU Gross Domestic Product, exceeding even 3% of it in some new member countries [3].

Some pessimistic prognoses show that the worldwide number of smokers continues to increase [4] and that the deaths caused by tobacco will double over the next few decades [5]. However, the trends of tobacco- related habits in the Western world are constantly decreasing. According to the latest health surveys in the US and in Europe, smoking prevalence among men and women has in general stabilized or is even decreasing. For example, in the US, the past month use of tobacco products was 29.4 % in 2005, while it was 30.4% in 2002 [6]; in the WHO European Region, smoking prevalence was estimated around 28.6% in 2005 but 28.8% in 2002. Falling death rates due to tobacco- related illnesses imply that trends in smoking prevalence have been curbed at least since the early eighties [7].

Findings from Western military surveys show similar trends and indicate overall declines in smoking as well. For example, in the total military population, the prevalence of any smoking in the US declined from 51.0% in 1980 to 32.2% in 2005 [8]. In the Canadian Forces, everyday smoking has decreased from 24% in 2000 to 20% in 2004; the latter figure is declared to be even lower than in the civilian population [9]. However, low smoking rates in the armed forces are not the case in every country, and cannot be generalized to all tobacco products or age groups [9]. In Estonia, for instance, we can observe the same smoking prevalence as elsewhere in Europe (i.e., 27.8%) in the general population [10], but the prevalence

is as high as 41.1% in the military population [11]. Recent findings also reveal that military personnel are more than twice as likely as civilians to use smokeless tobacco [12] and also indicate an increasing rate of tobacco use among young military members [13].

Inside the military, tobacco use rates and initiation or cessation related aspects are widely explored, especially in relation to the extra stress or excessive boredom military personnel might have experienced on duty. Being deployed has been found to be associated with higher rates of cigarette use [14]. There are an increasing number of regular smokers (including relapse and new initiation) of approximately 10% as well as an increase in daily consumption from an average of 15 cigarettes to 21 cigarettes [15]. The main reasons for increased smoking during deployments that have been cited are:

1) Stress, boredom, anxiety, and sleep deprivation;
2) Lack of alternate activities and privileges;
3) The perception that dangers in the field trump the negative health impact of smoking; and
4) A permissive military culture toward tobacco use [16].

With respect to managing stress, however, the research findings indicate that tobacco use is more likely to perpetuate a stress response rather than to suppress it, and that nicotine consumers are overall less effective in dealing with combat stress [17]. Unfortunately, not much can be found about the lastingness of post-deployment changes in smoking behaviour. One survey where the persistence of this behaviour is described indicates noticeable differences among sub-groups: a larger percentage of Army personnel began or increased their cigarette smoking one year after having deployed than stopped or reduced, whereas the opposite was reported for the other services [9].

3.2 TOBACCO USE AND MILITARY FITNESS

Clinical studies have reported that cigarette use is associated with a lower functional status [18] and a lower exercise tolerance among young adult people [19];[20]. Smoking has also been found to be a consistent and strong predictor of the lack of fitness for military duty, operationalized, e.g., in measures of physical health, mental health, substance abuse, and legal problems and of the occurrence of medical problems in training. It is even suggested that smoking be considered as a negative marker of readiness and be included in the services' fitness evaluations [21];[22]. Considering the frequency of injury incidents in training [23] and in infantry duties [24] related to cigarette smoking, it has been cited as an independent risk factor for both men and women [25] Similar findings about the harmful effect of cigarette smoking on physical fitness and readiness are described among U.S. Navy personnel [26].

It is shown that cigarette smoking adversely impacts troop readiness with increasing time off from duty [27], leading to poorer visual acuity [28], and together the exposure to fine dust being possibly related with the acute eosinophilic pneumonia [29]. However, the decreased fitness during a military exercise, even in harsh environments and in combination with poor dietary habits [30] is not clearly and explicitly identified. Study results remain controversial about the harmful effects of smokeless tobacco as well. On the one hand, there are results showing that using smokeless tobacco is an independent risk factor for injury proneness [31], that it has a detrimental effect on visuo-motor performance [32], and that it is associated with hypercholesterolemia [33] and higher blood pressure [34]. On the other hand, results indicate that even long-term use of smokeless tobacco does not significantly influence exercise capacity [35]. However, even while physical performance may remain unaffected, there is an increased risk of all kinds of oral problems for users [36];[37] and a negative effect on performance caused by deprivation symptoms, such as increased reaction time, self-rated withdrawal and decreased heart rate [38].

Military fitness is not only about physical health and hardiness. Several studies have reported the association between cigarette smoking and psychiatric illnesses. For currently enlisted personnel, smoking

is found to be one of the factors predictive of hospitalization for mental health disorders [39]. Regarding psychiatric illness research, in the target group with Post-Traumatic Stress Disorder (PTSD) or major depression, there is a higher prevalence of smoking. It refers to possible self-medication caused by the alleviating effect of nicotine on some symptoms like arousal, numbness, or detachment, which are related to these disorders [40]. The fact that poor mental health relates to failures in smoking cessation [41] indicates that for those people, quitting is even more difficult than for healthy people. It has also been shown that the overall quality of life among veterans is affected by poor health behaviours, even after controlling for the impact of co-morbid medical conditions [42]. Taking a closer look at the average level of self care among PTSD veterans, one can also observe quite low frequencies of preventive health behaviours and increased risks for non-fatal strokes and myocardial infarctions [43].

3.3 INTERVENTION OPPORTUNITIES

Often there is more than one health risk behaviour or kind of substance in use involved simultaneously [44];[45] and it is difficult to detect which of them is responsible for the given disease or harm. The fact that usually several risky behaviours are concurrently present is observable among teenagers in the civil population [46];[47] as well as among the adult population in a military environment (e.g., high-risk drinkers use seatbelts less frequently, are more likely to exceed speed limits while driving and smoke more than 20 cigarettes per day). Therefore, intervention programs should be implemented for all those behaviours (safe driving habits, smoking cessation, high-risk drinking) and to be tailored to the specific needs of the group at highest risk [48]. However, when expecting a positive change, one should be aware that people do not alter several behaviours at the same time and efforts to modify one kind of unhealthy behaviour into a healthy one will not necessarily affect other risky behaviours [49].

The struggle for a healthy lifestyle in the military is far from hopeless as tobacco interventions aimed at smoking cessation have proven to be effective among veterans [50] as well as active duty military personnel [51]. Others have provided an exhaustive list of evidence-based practices of tobacco-control programs and activities are described in depth [52], and clinical treatment approaches [53]. Still, more needs to be done to change the military culture, which has been invoked as a kind of excuse for tobacco consumption (i.e., a means for enhancing comfort or as a morale booster) in almost every article or health report dealing with this population. It has been proven that social influence encourages tobacco use [54], and role models of smoking behaviour in the military are strongly associated with the initiation and resumption of smoking, even after adjusting for other known risk factors [55]. Consequently, intervening with empty slogans or vague efforts is ineffective. Without trying to modify the organisational culture, a persistent change in behaviour can hardly be reached.

As an additional hidden menace to the culture of the Armed Forces, military personnel form an attractive market segment for tobacco producers. Manufacturers' business interests are expressed in manipulative messages, openly directed to military members with high effectiveness [56]. This should be taken into account when trying to protect military members from (re)starting tobacco use and when elaborating the strategy for tobacco use cessation. To reduce existing perverse incentives that lead to increased tobacco consumption, an effective tobacco control policy in the Armed Forces requires explicit implementation instructions and high-level organisational support [57]. Extra attention should be paid to formulate segment-specific messages for military members that counteract effectively with industry messages.

3.4 RECENT FINDINGS

A survey [58] was conducted among two rotations of Estonian soldiers deployed into Afghanistan to figure out the change in their perceived general health and smoking behaviour during the first three months of deployment as well as to explore the relations between declared changes in behaviour and the level of psychological well-being reported. The use of other tobacco products like snuff was not explored in this research. All respondents were white males.

Soldiers (n = 135) were asked if they had noticed a change in their:

1) General health;
2) Seeking help from a physician;
3) Being forced to stay away from duty because of aches;
4) Smoking behaviour; and
5) Frequency of physical fitness training compared with the period before deployment.

The questions of being a smoker versus non-smoker, and – if yes – the number of cigarettes smoked per day were not explicitly asked for. Nevertheless, the smokers could be distinguished from the non-smokers through item x shown below. Participants had three choices to answer an item indicating a change:

1) Negative change;
2) Positive change; or
3) No changes in the health related aspect considered.

Examples of items:

x. Compared with the period before deployment my smoking behaviour did …

1) Increase;
2) Decrease; and
3) Not change (did not start if non-smoker).

xx. Compared with the period before deployment my general health is …

1) Worse;
2) Better; and
3) Unchanged.

To assess psychological well-being, we asked them to fill out the well-being questionnaire World Health Organization-Five Well-Being Index (WHO-5) [59]. For both rotations, a survey was administered in the middle of their deployment (being May and August 2008, respectively) on their way to Rest and Recuperation[1] in Estonia.

Most participants declared no changes in assessed health related aspects in the middle of deployment (Figure 3-1). Some negative trend was found in all health related aspects but the second highest for Smoking behaviour (n = 29) after frequency of Fitness training (n = 40). In terms of positive change, we observed the highest change for the General health which was evaluated more positively (better general health) at the mid deployment as compared with the period before deployment.

[1] Rest and Recuperation stands for a short break in the middle of deployment, in which troops visit home or stay in a safe area near the theatre of operations.

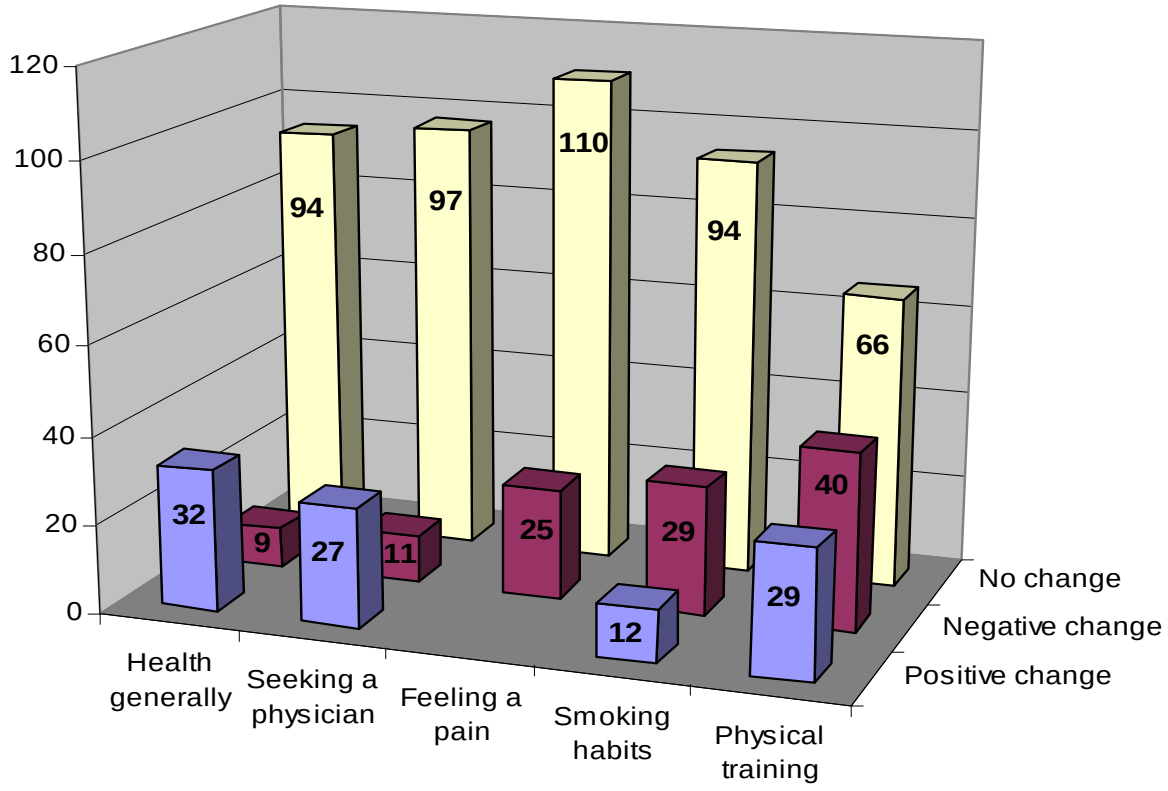

Figure 3-1: Dynamics of Self-Reported Changes in Health Related Aspects in the Middle of Deployment.

The odds ratios in change (positive against negative changes) are also very informative. If the number is higher than 1 than there are proportionally more positive changes than negative ones; and if the number is lower than one, then there are more negative changes as compared to the positive ones. The odds ratio for General health is 3.5; this means that there are approximately 3.5 times more positive changes than negative ones. On the contrary, the odds ratio for Smoking behaviour is 0.30; in other words, there are about three times more negative changes than positive ones.

The matrix presented in Table 3-1 shows correlations between health-related aspects measured among all respondents (n = 135). Higher scores on the scales indicate a positive change: better psychological well-being, better general health, fewer visits to a physician, less excessive aches, decreased smoking, and more physical fitness training. Hence, higher positive correlations have a positive connotation. Results reveal that the correlations between Smoking behaviour and Psychological well-being (r = .31), General health (r = .36), and Aches (r = .28) are positive and significant ($p < .01$). Notwithstanding the fact that correlations do not allow for any causal relationship between the variables, the results show that the observed negative changes in tobacco use (thus more smoking – see Figure 3-1) and in general health is correlated with poorer psychological well-being during the first three months of deployment.

Table 3-1: Correlations Between Psychological Well-Being and Health Aspects.

	Psy.WB	Gen.Hlth	Seek.Phy	Ex. Aches	Smoking
Psychological WB	–				
General Health	.33*	–			
Seeking a Physician	.11	.38*	–		
Excessive Aches	.25	.31*	.14	–	
Smoking Behaviour	.31*	.36*	.05	.28*	–
Fitness Training	.04	.37*	.21	.14	.21

Note. Psy.WB – Psychological Well-Being, Gen.Hlth – General Health, Seek.Phy – Seeking a Physician, Ex.Aches – Excessive Aches, Smoking – Smoking Behaviour

** $p < .01$*

3.5 DISCUSSION

Findings from empirical part of the review concur with the line of previous research indicating that on deployments smoking behaviours is increase. Together with the perceived state of general health, smoking impacts soldiers' psychological well-being. It is shown that soldiers who experience problems with their general health and whose smoking behaviour become more frequent are more vulnerable to mental distress. On the other hand smoking behaviour itself is predicted by the state of general health and presence of aches. It seems to be a closed circle of afore mentioned self medication where one problem is cured with the other and no easy solution is available. Military personnel on deployments are relatively young. Considering the remarkable time lag between tobacco use and its consequences, we might expect the harm to become more disturbing among older soldiers and among retired military members and veterans in terms of restricting their everyday activities, impairing quality of life, and reducing life expectancy.

In contrast with alcohol consumption or risky driving, there is not such an immediate impact of tobacco habits and the harm caused by those bad habits, such as increased death, premature deceases, serious injury rates or severe diseases found during the active duty service period. In active duty the impact of tobacco use on general health and specifically on military performance can be defined rather more indirectly. However, this indirect impact (e.g., injury proneness, deprivation symptoms, higher blood pressure, impaired vision acuity) of tobacco related behaviour may still decrease troops' fitness for military operations and should be the target of performance enhancement activities. Based on research recommended interventions include:

1) Working out an intervention programs tailored to the specific needs of the group at highest risk;
2) Elaborating the strategy to modify the military culture which encourage tobacco use;
3) Developing an effective tobacco control policy in the Armed Forces with explicit implementation instructions and high-level organisational support; and
4) Formulating segment-specific messages for military members that are able to counteract effectively with messages from tobacco industries.

Research has shown that, instead of pointing to the manipulations by the tobacco industry or to the unhealthy effects of tobacco use, there are four promising themes for tobacco control efforts in the military. Messages to this population should emphasise that:

1) Smoking decreases one's ability to positively influence others;

2) Smoking increases the chance that a military member will be discharged from the military prematurely;

3) Smoking lowers the readiness to fight and to win wars; and

4) Smokers are not as productive as other military personnel [60].

3.6 REFERENCES

[1] World Health Statistics 2008. Part 1 Ten highlights in health statistics. Reducing deaths from tobacco.

[2] WHO The world health report (2002). Reducing Risks, Promoting Healthy Life (http://www.who.int/whr).

[3] WHO Regional Office for Europe. The European Tobacco Control Report 2007 (http://www.euro.who.int).

[4] Guindon, G. E. and Boisclair, D. (2003) Past, current and future trends in tobacco use. Washington, DC, World Bank (http://www1.worldbank.org).

[5] WHO Report on the Global Tobacco Epidemic, 2008: The MPOWER package, Geneva, World Health Organization, 2008 (http://www.who.int).

[6] Substance Abuse and Mental Health Services Administration. (2006). Results from the 2005 National Survey on Drug Use and Health: National Findings (Office of Applied Studies, NSDUH Series H-30, DHHS Publication No. SMA 06-4194). Rockville, MD. (http://www.samhsa.gov).

[7] WHO Regional Office for Europe (2007). The European tobacco control report 2007 (http://www.euro.who.int).

[8] RTI International (2006) 2005 Department of Defence Survey of health Related Behaviours among Active Duty Military Personnel. RTI/7841/106-FR.

[9] Directorate of Force Health Protection CF Health Services Group (2005). Canadian Forces Health and Lifestyle Information Survey 2004 Regular Force Report A-MD-015-FHP/AF-002.

[10] Estonian National Institute for Health Development. Health behaviour among the Estonian adult population 2006 (http://www2.tai.ee/uuringud).

[11] Estonian National Institute for Health Development (2008). Prevalence of smoking behaviour in Estonian Defence Forces. (preliminary data).

[12] Peterson, A.L., Severson, H.H., Andrews, J.A., Gott, S.P., Cigrang, J.A., Gordon, J.S., Hunter, C.M. and Martin, G.C. (2007). Smokeless tobacco use in military personnel. Military Medicine, 172, 1300-1305.

[13] Nelson, J.P. and Pederson, L.L. (2008). Nicotine & Tobacco Research, 10, 775-790.

[14] Federman, B.E., Bray, M.B. and Kroutil, L.A. (2000). Relationships between substance use and recent deployments among women and men in the military. Military Psychology, 12, 205-220.

[15] Boos, J.C. and Coft, A.F. (2004). Smoking rates in the staff of a military field hospital before and after wartime deployment. Journal of the Royal Society of Medicine, 97, 20-22.

[16] Poston, W.S.C., Taylor, J.E., Hoffman, K.M., Peterson, A.L., Lando, H.A., Shelton, S. and Haddock, C.K. (2008). Smoking and Deployment: Perspectives of Junior-Enlisted U.S. Air Force and U.S. Army Personnel and Their Supervisors. Military Medicine, 173, 441-447.

[17] Stein, R.J., Pyle, S.A., Haddock, C.K., Poston, W.S.C., Bray, R. and Williams, J. (2008). Reported stress and its relationship to tobacco use among U.S. military personnel. Military Medicine, 173, 271-277.

[18] Eriksen, W., Natwig, B., Rutle, O. and Bruusgard, D. (1999). Smoking and functional status of young adults. Scandinavian Journal of Primary Health Care, 17, 174-179.

[19] Papathanasiou, G., Georgakopoulos, D., Georgoudis, G., Spyropoulos, P., Perrea, D. and Evangelou, A. (2007). Effects of chronic smoking on exercise tolerance and on heart rate-systolic blood pressure product in young healthy adults. European Journal of Cardiovascular Prevention and Rehabilitation, 14, 646-652.

[20] Kimura, Y., Nakamoto, Y., Shitama, H., Ohmine, S., Ide, M. and Hashisuka, K. (2007). Influence of moderate smoking on physical fitness and local muscle oxygenation profile during incremental exercise. Journal of UOEH, 29, 149-158.

[21] Haddock, C.K., Pyle, S.A., Poston, W.S.C., Bray, R.M. and Stein, R.J. (2007). Smoking and Body Weight as Markers of Fitness for Duty among U.S. Military Personnel. Military Medicine, 172, 527-532.

[22] Snoddy, R.O. and Henderson, J.M. (1994). Predictors on basic infantry training success. Military Medicine, 159, 616-622.

[23] Reynolds, K.L., Heckel, H.A., Witt, C.E., Martin, J.W., Polland, J.A., Knapik, J.J. and Jones, B.H. (1994). Cigarette smoking, physical fitness, and injuries in infantry soldiers. American Journal of Preventive Medicine, 10, 145-150.

[24] Reynolds, K.L., White, J.S., Knapik, J.J., Witt, C.E. and Amoroso, P.J. (1999). Injuries and risk factors in a 100-mile (161-km) infantry road march. Preventive Medicine, 28, 167-173.

[25] Knapik, J.J., Sharp, M.A., Canham-Chervak, M., Hauret, K., Patton, J.F. and Jones, B.H. (2001). Risk factors for training-related injuries among men and women in basic combat training. Medicine and Science in Sports Exercise, 33, 946-954.

[26] Van Orden, K.F. and Nice, D.S. (2008). National security interests at the naval health research center. In A.D. Mangelsdorff (Ed.), Psychology in the service of national security (pp. 55-70). Washington, DC: American Psychological Association.

[27] Zadoo, V., Fengler, S. and Catteson, M. (1993). The effects of alcohol and tobacco use on troop readiness. Military Medicine, 158, 480-484.

[28] Sharma, R.R. (2009). Visual effect of long-term active smoking: Are air-crew flying NVG aided missions at a disadvantage? Paper presented at 57-th International Congress of Aviation and Space Medicine, Zagreb, 2009.

[29] Shorr, A.F., Scoville, S.L., Cersovsky, S.B., Shanks, G.D., Ockenhouse, C.F., Smoak, B.L., Carr, W.W. and Petruccelli, B.P. (2004). Acute eosinophilic pneumonia among US Military personnel deployed in or near Iraq. The Journal Of The American Medical Association, 292, 2997-3005.

[30] Defence Science and Technology Organisation Victoria (Australia) Aeronautical and Maritime Research Lab (2002). The Effect of Consumption of Australian Combat Rations on Military Personnel after a Medium-Term Field Exercise (http://handle.dtic.mil/100.2/ADA399668).

[31] Heir, T. and Eide, G. (1997). Injury proneness undergoing a physical training programme: smokeless tobacco use, higher age, and low levels of physical fitness are risk factors. Scandinavian Journal of Medicine & Science in Sports, 7, 304-311.

[32] Contreras-Vidal, J.L., Van den Heuvel, C.E., Teulings, H.L. and Stelmach, G.E. (1999). Visuo-motor adaptation in smokeless tobacco users. Nicotine & Tobacco Research, 1, 219-227.

[33] Tucker, L.A. (1989). Use of smokeless tobacco, cigarette smoking, and hypercholesterolemia. American Journal of Public Health, 79, 1048-1050.

[34] Bolinder, G. and De Faire, U. (1998). Ambulatory 24-h blood pressure monitoring in healthy, middle-aged smokeless tobacco users, smokers and non-tobacco users. American Journal of Hypertension, 11, 1153-1163.

[35] Bolinder, G., Noren, A., Wahren, J. and De Faire, U. (1997). Long-term use of smokeless tobacco and physical performance in middle-aged men. European Journal of Clinical Investigation, 27, 427-433.

[36] Robertson, P.B., De Rouen, T.A., Ernster, V., Grady, D., Greene, J., Mancl, L., McDonald, D. and Wash, M.M. (1995). Smokeless tobacco use: how it affects the performance of major league baseball players. Journal of the American Dental Association, 126, 1115-1121.

[37] Robertson, P.B., Walsh, M.M. and Greene, J.C. (1997). Oral effects of smokeless tobacco use by professional baseball players. Advances in Dental Research, 11, 307-312.

[38] Keenan, R.M., Hatsukami, D.K. and Anton, D.J. (1989). The effects of short-term smokeless tobacco deprivation on performance. Psychopharmacology, 98, 126-130.

[39] Booth-Kevley, S. and Larson, G.E. (2005). Predictors of Psychiatric Hospitalization in the Navy. Military Medicine, 170, 87-93.

[40] RAND Centre for Military Health Policy Research (2008). Invisible Wounds of War (http://www.rand.org).

[41] Hemmingsson, T., Kriebel, D., Tynelius, P., Rasmussen, F. and Lundberg, I. (2008). Adolescent mental health predicts quitting smoking in adulthood: a longitudinal analysis. European Journal of Public Health, 18, 66-70.

[42] Borzecki, A.M. and Lee, A. (2005). Do poor health behaviours affect health-related quality of life and healthcare utilization among veterans? Journal Ambulatory Care Manage, 28, 141-156.

[43] Buckley, T.C., Mozley, S.L., Bedard, M.A., Dewulf, A.C. and Greif, J. (2004). Preventive health behaviours, physical morbidity, and health related role functioning impairment in veterans with post-traumatic stress disorder. Military Medicine, 169, 536-540.

[44] Centres for Disease Control and Prevention. Youth Risk Behaviour Surveillance – United States. Surveillance Summaries, 2007. MMWR 2008;57(No. SS-4) (http://www.cdc.gov/mmwr).

[45] The Information Centre, Lifestyles Statistics (2008). The health survey for England 2006. (http://www.ic.nhs.uk).

[46] Pesa, J.A. (1998). The association between smoking and unhealthy behaviours among national sample of Mexican-American adolescents. The Journal of School Health, 68, 376-380.

[47] National Centre for Social Research (2007). Smoking, drinking and drug use among young people in England in 2006 (http://www.ic.nhs.uk).

[48] Williams, J.O., Bell, N.S. and Amoroso, P.J. (2002). Drinking and other risk taking behaviours of enlisted male soldiers in the US Army. Work, 18, 141-150.

[49] Naval Health Research Centre (1998). Relationships Among Changes in Health Behaviours in a Six-Year U.S. Navy Cohort.

[50] Beckham, J.C., Becker, M.E., Hamlett-Berry, K.W., Drury, P.D., Kang, H.K., Wiley, M.T., Calhoun, P.S., Moore, S.D., Bright, M.A. and McFail, M.E. (2008). Preliminary Findings from a Clinical Demonstration Project for Veterans Returning from Iraq or Afghanistan. Military Medicine, 173, 448-453.

[51] Morgan, B.J. (2001). Evaluation of an educational intervention for military tobacco users. Military Medicine, 166, 1094-2004.

[52] IOM (Institute of Medicine). 2009. Combating Tobacco Use in Military and Veteran Populations. New York, NY: The Guilford Press.

[53] Peterson. L.P. (2006). Clinical health psychology and behavioural medicine in military healthcare settings. In C.H. Kennedy and E.A. Zillmer (Eds.), Military psychology: Clinical and Operational Applications (pp. 74-104). Washington DC: American Psychological Association.

[54] Bray, R.M. and Brown, J.M. (2008). Influence of military leaders, units, and deployment on tobacco use. Paper presented at 50th Annual conference of the International Military Testing Association, Amsterdam 2008 (www.imta.org).

[55] Bray, R.M., Pemberton, M.R., Williams, J., Green, K.J. and Hunter, C.M. (2008). Peer and role model influences on cigarette smoking. Paper presented at 50th Annual conference of the International Military Testing Association, Amsterdam 2008 (www.imta.org).

[56] Joseph, A.M., Muggli, M., Pearson, K.C. and Lando, H. (2005). The Cigarette Manufacturers' Efforts to Promote Tobacco to the U.S. Military. Military Medicine, 170, 874-880.

[57] Arvey, S.R. and Malone, R.E. (2008). Advance and Retreat: Tobacco control policy in the U.S. military. Military Medicine, 173, 985-991.

[58] Unpublished survey.

[59] Bech, P., Olsen, L.R., Kjoller, M. and Rasmussen, N.K. (2003). Measuring well-being rather than the absence of distress symptoms: a comparison of the SF-36 Mental Health subscale and the WHO-Five Well-Being Scale. International Journal of Methods in Psychiatric Research, 12, 85-91.

[60] Hoffman, K.M., Haddock, C.K., Poston, W.S.C., Taylor, J.E., Lando, H.A. and Shelton, S. (2008). A formative examination of messages that discourage tobacco use among junior enlisted members of the United States military. Nicotine & Tobacco Research, 10, 653-661.

Chapter 4 – A REVIEW OF MILITARY RESEARCH INTO ALCOHOL CONSUMPTION

by

Neil G. VERRALL, PhD (GBR)

ABSTRACT

Alcohol consumption is a part of military history. The impacts in terms of both short-term and long-term consequences require modern militaries to develop and instigate a duty of care for its personnel, which informs the military's 'cradle to the grave' approach in addressing alcohol consumption and other risky health behaviours (e.g., smoking, driving, sex, drugs, obesity). Thus, in recent years there have been numerous studies that have either focused on, or included, measures of alcohol consumption among various military populations, mostly among NATO countries. Therefore, a synthesis of this research is warranted in order to provide a contemporary understanding of this topic for NATO forces. This review addresses the military research regarding alcohol consumption. It reviews the methodological issues associated with the breadth of research, as well as commenting on a range of factors that need to be considered when interpreting and comparing the different research studies; for example:

1) *When comparing findings across military to civilian and pan-military populations;*
2) *Deployment-related research;*
3) *Military groups at risk; and*
4) *The impact on readiness, operational effectiveness and force sustainability.*

4.1 INTRODUCTION

The military has a historical relationship with alcohol, as anyone who has read military history or the vast number of military autobiographies will testify. The modern military, including NATO, is concerned with excessive alcohol consumption because it not only affects the long-term health of its personnel, but also because the short-term impacts contribute toward accidents, injuries and the premature death of service personnel, which ultimately affects military performance and capability; for example, it has been suggested that behavioural pathways underpinning risky drinking behaviour contribute to the increased rate of injury deaths of US Persian Gulf War veterans [1]. Also, it was found that consuming more than five drinks per week contributed to the risk factors associated with premature deaths from unintentional injuries among US army personnel between 1990 and 1998 [2]. Excessive, heavy and persistent alcohol use and abuse also affects personal relationships, contributes to domestic violence, the breakdown of families and anti-social behaviour [3]. This review addresses some of the important issues associated with the military research into, and involving, alcohol consumption.

4.2 CIVILIAN-MILITARY COMPARISONS

There is a general assumption that the military consume more alcohol than comparable civilian populations. Numerous publications have compared military samples against civilian drinking rates and the findings suggest that this general assumption can be supported [4]-[10]. However, some have cautioned against some of these findings due to methodological problems in comparing these populations [11]. Limitations include cross-sectional designs, comparing non-equivalent surveys [4];[10], differing definitions of alcohol consumption, e.g., the level of consumption that defines binge drinking or heavy drinking [4];[6], and inappropriate statistical procedures [6].

An historical analysis of alcohol-related hospitalisation trends between the US army and US civilian populations (1980 – 1995) found valid and reliable differences between military and civilian populations. Thus there were variations among abuse trends according to the abuse type; for example, the army sample possessed higher rates for dependent alcohol-related disorders, whereas civilians possessed higher rates of polydrug use (i.e., the dual use of drugs and alcohol). However, overall hospitalisation rates for alcohol-related trends were similar for both populations [11]. A further US study compared military veterans with civilians in terms of historical alcohol treatment rates and exposure episodes. The results suggested similar patterns among the younger age groups, but military veterans possessed higher drinking rates among the older age groups, suggesting persistent engagement in a risky health behaviour that possesses implications for long-term negative health effects, both physical and mental [12].

Two UK studies found that excessive alcohol consumption is more common in the armed forces than in the general population [7];[8]. It was found that the tri-service (i.e., army, navy and air force) military samples had higher rates for hazardous drinking, severe drinking, alcohol dependence, alcohol-related harm and Heavy Episodic Drinking (HED, or 'binge drinking'). Not only that, but military females had higher rates of HED than civilian males. Furthermore, when compared to age-matched civilian samples, a sample from the British Royal Navy was found to display excessive alcohol consumption, especially HED [8]. This is supported by another UK study, which found that a UK military sample had higher rates of HED compared to civilian rates, and that this difference persisted over a three-year follow-up period [9].

So what do these studies suggest about civilian-military comparisons of alcohol use? The assumption that the military tend to engage in higher rates of alcohol consumption than comparable civilian populations can still be supported. This is particularly the case for heavy drinking and HED groups [5];[7]-[8];[13]. Numerous studies have found that demographic risk factors for higher rates of alcohol use include being young, single or unmarried, male, lower educational attainment, white, a smoker, and from among the non-commissioned (enlisted) ranks [7]-[8];[13]. These broader demographic variables suggest an underlying 'at risk' group, irrelevant of being in the military or a civilian. If there is something unique about the military as an organisation and a culture then it may require further investigation. Specifically, the military could be compared to other, more relevant, civilian samples and sub-cultures, e.g., the uniformed emergency services (i.e., police, fire), university student populations, and amateur sports teams. Until then, there remain unanswered questions about the phenomenology of military drinking; which drives further research but is also limited by the aforementioned methodological limitations that hinder such advancement [7];[11];[13]. Therefore, there is a requirement for large-scale, longitudinal studies that use valid, reliable and consistent measures to gather prospective data between matched and representative samples (and sub-samples) among military and civilian populations.

4.3 MILITARY-MILITARY COMPARISONS

When considering the previous evidence regarding civilian-military comparisons, it would be prudent to review the military samples used in this research and also the military-centric studies. There are four core issues that need to be considered:

- Inter-service sub-cultures (between the army, navy and air force);
- Inter-cultural differences (between multi-national and coalition force Nations); and
- Professional versus conscript forces:
    - The applied context in which the study was conducted (e.g., recruitment, operational, training).

Firstly, inter-service sub-culture refers to the assumed differences between the individual components of the army, navy and air force. Individual force differences between the respective land, air and maritime components are often assumed and accepted (i.e., referred to as 'received wisdom'), but often lacks the empirical basis for such assumptions. In terms of alcohol use, the army has been found to have higher rates

of alcohol consumption than the navy and air force [13], whereas others have found statistically higher consumption rates for the navy and army compared to the air force [7]. In one US study, alcohol consumption was measured on different forces (i.e., army, navy, air force, marines) but no comparison findings were reported [14]. Furthermore, intra-component differences have been found. That is, any observed difference found within one force (e.g., within-army). For example, within the army it has been found that the more frontline and combat-related trades (e.g., infantry) have been found to be a high-risk drinking group and have higher rates of alcohol use [15]. A UK study found mixed results [16]. At pre-deployment, there were no differences found between the Combat Arms (CA) (e.g., infantry, cavalry), Combat Service (CS) arms (e.g., engineers, artillery) and Combat Service Support (CSS) arms (e.g., admin, signals, logistics) on measures of alcohol frequency *and* HED; however, there was a significant difference for the *amount* of alcohol consumed, with the CA consuming more than the CSS. At post-deployment, the CA engaged in more HED than the CSS, but there were no further differences between CA, CS and CSS for either frequency or amount of alcohol consumed.

Secondly, as well as inter- and intra-component differences, the issue of cultural differences among multi-national forces and coalition partners also requires consideration, especially within the context of NATO forces. For example, to what extent does alcohol intake (as well as smoking, drug, sex and driving behaviour) differ between various Nations' militaries? It has been anecdotally suggested that similar international components may have more in common than intra-national components. That is to say, it is hypothesised that international armies (or navies) may engage in more risky alcohol consumption than international air forces. There appears to be an absence of published military studies that have directly investigated this issue; therefore, it is a suggestion for future military health research. An attempt was made to compare the results from different Nations' studies referenced within this chapter, however, it became impossible to do so because of the methodological problems suggested previously, for example:

a) Different survey tools were used to measure alcohol consumption;

b) If similar tools were used then there were differences in the statistical tests used and the results reported; and

c) Differing amounts were used to define categories such as HED, heavy drinking, risky drinking, etc.

Previously, a NATO report was produced on the topic of *'Multi-National Military Operations and Intercultural Factors'* (NATO HFM RTG-120). The report discusses broad cultural factors, including health and well-being, and is worth further consultation for an appreciation of cultural military differences [17].

Thirdly, the issue of professional versus conscript forces refers to the inherent differences between national forces that are made up solely of volunteers (i.e., professional), or a predominantly conscript force. This rationale suggests that because conscript forces are largely composed of individuals who must undergo a period of compulsory military service, their population will largely reflect their own civilian population, once age and gender are taken into consideration. Therefore, it could be assumed that any observed behavioural differences (e.g., alcohol consumption) may not be as pronounced between military conscripts and civilian samples. Such a study could help improve knowledge regarding the issue of military culture and the socialisation processes involved in military drinking behaviour; for example, pre- and post-conscript drinking behaviour compared against that Nation's civilian drinking patterns and behaviours. Published studies addressing alcohol use and conscript forces are sparse; however, this review identified one published report that addressed alcohol use and abuse among Greek navy conscript recruits [18], but a comparison to civilian drinking rates could not be established.

Finally, consideration of the context in which the study was conducted is essential. The majority of military health studies tend to be for health surveillance purposes, and as such, are either cross-sectional and/or retrospective. Examples of studies addressing alcohol consumption in military samples include:

recruits [18]-[20], the trained strength [7]-[8];[21], deployments [14];[16];[22]-[23] and veterans [12];[24]. Contexts such as these require careful consideration because their inherent nuances provide potential confounding factors that could affect subsequent interpretations and comparisons.

4.4 MILITARY DEPLOYMENTS

In terms of deployment-related research, the military can be deployed for a number of reasons, e.g., direct intervention (warfighting), peace enforcement, peacekeeping, humanitarian assistance, as well as for training and exercises. Therefore, this will influence the types (and levels) of stress, workload, length of deployment and environment that the military force will experience. These factors will inherently influence the types of health behaviours engaged in, including the provision, consumption or abstinence of alcohol. There are a number of deployment-related studies that include measures on alcohol consumption, however, there is a dearth of prospective and longitudinal (repeated measures) studies on military health behaviour across the deployment cycle (i.e., pre-, during and post-deployment) when compared to the number of epidemiological, cross-sectional, and retrospective research that is primarily used for informing general health surveillance. In fact, it has been suggested that *'many aspects of the deployment experience have not been well studied, including its effects on substance use'* [14]. The following sub-sections will address the research conducted around the deployment cycle.

4.4.1 Pre-Deployment

Pre-deployment alcohol use was used as a predictor in a sample of US National Guard soldiers [25], which found that negative mental health variables, younger age and being unmarried predicted greater total drinking and higher frequency of HED. Another US study looked at alcohol use and alcohol-related problems at pre- and post-deployment [23], although the data was based on baseline and follow-up data from the US Millennium Cohort Study. It was found that individuals who deployed and reported combat exposure were at increased risk of new-onset heavy weekly drinking, HED and alcohol-related problems. However, others have found that only certain types of combat exposure were associated with changes in alcohol consumption and deployment experience across a three-year period [9].

A recent UK study [16] collected quantitative and qualitative data in a longitudinal, prospective study of risky health behaviours (alcohol, sex, driving, smoking), risk-taking personality (impulsive sensation seeking – ImpSS), psychological well-being and risk perceptions across the deployment cycle (pre-, during, post-). The sample was taken from a UK army battalion deployed to Iraq in 2007 (Op TELIC 10) and found that self-reported alcohol consumption only significantly reduced at post-deployment (compared to pre-deployment) for the *amount* of alcohol consumed on a typical day when drinking, but there were no significant differences for *frequency* of drinking or for HED between pre- and post-deployment. Additionally, the numbers for 'current drinkers' (i.e., ~95%) did not change across pre- and post-deployment.

4.4.2 During Deployment

There appears to be a dearth of published, prospective research that has collected measures of alcohol consumption during a deployment or operation. Within the aforementioned UK study [16], alcohol intake significantly reduced during deployment, which was to be expected as most Nations operate a no alcohol (i.e., 'dry') policy on operations. However, as illustrated in Table 4-1 below, investigation of the mid-deployment sample (N = 889) found that 2.9% perceived their alcohol intake had increased on deployment, whereas 5.8% perceived that their alcohol intake was about the same since being on deployment (compared to pre-deployment). Further analysis of mid-deployment alcohol consumption showed that the high-ImpSS group reported statistically higher levels of consumption for *frequency* and HED, but not for the *amount* for alcohol consumed. This highlights the issue of 'black market' access to contraband alcohol on military deployments or the abuse of restricted access, e.g., the 'two-can rule'. This is supported by

qualitative responses for deployed personnel [16], whereby a small minority of individuals can still gain access to alcohol, either through the postal system or via logistic supply, which differs across multi-national partners. This highlights the disparity between prohibitive alcohol policies by some military Nations and the small minority who gain access to alcohol on deployments. Currently in Afghanistan different Nations contributing to ISAF possess different policies on alcohol consumption, which could be a potential source of friction among Nations, as well as influencing illicit alcohol consumption among those Nations with a no alcohol policy, but where consuming alcohol is still possible.

Table 4-1: Self-Report Measures of Alcohol Intake of UK Army Sample Deployed to Iraq [16].

	Frequency (%) of perceived alcohol change		
	Pre-deployment	During deployment	Post-deployment
Increased alcohol intake	28.2	2.9	21.1
Intake about the same	53.4	5.8	55.1
Reduced alcohol intake	18.4	91.3	23.8

4.4.3 Post-Deployment

Post-deployment alcohol consumption is of interest because it possesses important readjustment and mental health implications associated with the experiences gained on deployments and operations (e.g., reactions to combat exposure, traumatic experiences, separation, stress). Post-deployment alcohol consumption has been prospectively investigated within the UK army, as previously mentioned [16]. Table 4-1 presents self-report measures of alcohol intake at each stage of the deployment.

These findings challenge some of the generalised assumptions which suggest that alcohol intake increases at post-deployment. However, a different UK study [9], which was a prospective, longitudinal study over a three-year period, found that the increased levels of alcohol consumption at follow-up were greater for those that had been deployed since the baseline measure three years previously. However, there was a statistically significant increase in alcohol consumption across the sample, irrespective of whether they had been deployed or not.

Within the US studies, alcohol use has been investigated in terms of combat exposure and post-combat invincibility [26]. Combat experience factors were found to be predictive of post-deployment risk-related behaviours, including frequency and amount of alcohol use; although the combat experience of seeing a *buddy killed/injured* was protective against post-deployment driving under the influence of alcohol or riding with a driver who had been drinking. Findings such as these illustrate the complexity of alcohol consumption following military deployment (including other risky health behaviours) and highlight an important issue of *when* measures of health and behaviour are collected at post-deployment, e.g., upon immediate return, after one month, six months, 12-months.

4.4.4 Persistence of Alcohol Use Behaviour

The persistence of health behaviours, directly related to deployments, has not yet been reliably established, due mainly to the methodological issues previously mentioned and a lack of repeated measures, prospective research in the area. Furthermore, measures of post-deployment health behaviours tend to be cross-sectional and taken at one point in time, as opposed to repeated measures across post-deployment timelines (e.g., 1, 6, 12-months after returning). Therefore, it is not currently known if changes in post-deployment alcohol consumption are consistent over time, or a product of temporal and situational factors, such as immediate post-deployment celebrations, enduring mental health issues after combat exposure, or current contextual factors (e.g., relationship problems) or whether they are directly related to those

who have been deployed compared to the non-deployed, as found by many military health surveys and epidemiological studies [2];[7];[13]-[14];[24]-[27].

Aspects of research have attempted to address the issue of persistent alcohol use. In a sample of UK military personnel who were deployed to Iraq in 2003, it was found that the subsequent prevalence of severe alcohol problems (post-deployment) increased with the duration of deployment [28]. It was also found that greater alcohol misuse was higher in men who had deployed, as compared to those who had not deployed or when compared to female groups [29]. However, the author's also suggest a general increase in risky alcohol use in the military (deployed or not) compared to national survey data, which has been supported by others [7];[13]. Additionally, longitudinal tracking of alcohol consumption increased over a three-year period in a sample of UK armed forces personnel, as previously mentioned [9].

Finally, a more considered understanding regarding post-deployment and persistent alcohol use is required. It is expected that short-term levels of alcohol consumption will increase at post-deployment, as personnel have been away from alcohol for many months, and they may wish to celebrate their return with friends, family and colleagues. However, what is less known is how long the persistent use of alcohol continues, and at what levels (e.g., amount, frequency and HED). This knowledge is important for future health outcomes, as well as identifying which groups are at increased susceptibility to this risky health behaviour. Additionally, as health behaviours tend to co-exist then this also has implications for other risky health behaviours (i.e., smoking, sex, drugs and driving).

4.5 MILITARY SUB-GROUPS AT RISK

'At risk' sub-groups exist within the military organisation; for example, risk-takers and individuals who are high in sensation seeking tendencies are considered to be an at-risk group for risky alcohol behaviour [30]-[31]. Therefore, if the levels of drinking behaviour reported in military studies are to be believed, and the nature of Sensation Seeking in the military is considered [16];[30]-[31] then the military will contain a significant proportion of personnel who could be considered at increased risk. As previously mentioned, levels of ImpSS and risky health behaviours have been investigated [16] and it was found that the high-ImpSS group tended to drink more than the low-ImpSS group on all items of alcohol consumption (amount, frequency and HED) and across all phases of an operational deployment. This high-ImpSS group also tended to drive faster, wear seatbelts less, tended to be smokers (and smoke more) and engage in risky sex when compared to the low-ImpSS group. Alcohol consumption has also found to be predictive of both recreational gamblers and individuals with some gambling-related problems in a large sample of US air force recruits [32].

The most obvious 'at risk' sub-group within the military is that which is young, single or unmarried, male, lower educational achievement, white, a smoker, and from among the non-commissioned (enlisted) ranks. Such demographic variables would also account for findings showing that more frontline combat units have higher rates of alcohol use than some support and rear echelon units, which tend to contain more females and have an older age profile [15]-[16]. Furthermore, it has been found that staying in the military and moving relationship status (from married to either divorced, separated or widowed) were also significant risk factors for increased heavy drinking [13]. Also, it was found that alcohol dependence was one of the most common diagnoses in military veterans and that heavy drinking behaviour extends into post-service life for vulnerable individuals who leave the forces [33], which is supported by others [12].

In terms of mental health issues, heavy drinking has been consistently found to be related to poor subjective physical and psychological health. There is also a consistent body of evidence reporting the association between increased and/or heavy use of alcohol and combat exposure, leading to Post-Traumatic Stress Disorder (PTSD) and depression [34]-[36]. High rates of alcohol and drug abuse have been found in traumatised adults; whereby alcohol is one of the oldest forms of self-medication for individuals with PTSD, and can be an effective short-term medication for sleep disturbances, nightmares and other intrusive PTSD symptoms [37].

4.6 IMPACT UPON OPERATIONAL READINESS, EFFECTIVENESS AND FORCE SUSTAINABILITY

4.6.1 Readiness

It is often reported that risky health behaviours, including risky alcohol consumption, can affect pre-deployment preparation and military readiness [14];[25]. However, there appears to be a dearth of evidence supporting a direct, causal pathway. In fact, in anticipation of impending combat exposure on future operational deployments, anecdotal evidence suggests that alcohol consumption can be conspicuously tolerated, or even encouraged, e.g., pre-deployment parties and social activities with friends, family and colleagues. The qualitative data collected in one UK study also supports this [16].

A US study reported that 13% of soldiers felt they needed to cut down their alcohol consumption prior to deployment, and that 17% of soldiers were using alcohol more than they intended [38]. In support of this, a UK study found that 28% of a UK army sample preparing to go to Iraq perceived that they had increased their alcohol intake in their pre-deployment phase. This is compared to 18% who perceived they had reduced their alcohol intake (Table 4-1) [16].

4.6.2 Operational Effectiveness

It is an intuitive assumption that risky health behaviours, especially alcohol use and abuse, possess serious consequences for performance and effectiveness on deployed operations; this has been reinforced in various papers [7];[39]. However, as with ‘readiness’, the direct impact is difficult to assess when one considers the context within which ‘effectiveness’ is measured, i.e., how is ‘*operational effectiveness*’ defined, and are the measures used to assess it valid and reliable? Therefore, without applied research that is conducted in the operational environment it is only possible to assume that alcohol impairment *could* have detrimental effects upon operational performance and effectiveness. Furthermore, the role of moderate alcohol for social cohesion is an important factor. This has been found in qualitative data provided by UK army personnel at pre- and post-deployment [16] and has been alluded to by others [7];[39]. The important factor in terms of this issue is low-moderate alcohol consumption (within national guidelines) and not the heavy, binge or abusive use of alcohol.

4.6.3 Force Sustainability

Modern professional forces possess smaller numbers of personnel than they have historically. This is evident within certain NATO forces, whereby previously large conscript forces have since professionalised and had to reduce personnel numbers in order to become an efficient and sustainable force. Likewise, even established professional forces have reduced manpower over the years to meet future strategic transformation. Therefore, it is imperative that such forces maximise their available manpower for long-term sustainability and capability, as well as operational performance and effectiveness.

In a US study on operational tempo and well-being among US soldiers it was found that low alcohol use moderated the impact of work hours on physical symptoms, but only when work hours were short [40]. If the work hours were few and the soldiers drank more then physical symptoms increased. The researchers rightly conclude that the use of alcohol by military personnel is complex and multi-dimensional. That is to say that many factors, e.g., predispositions, contexts, environments and perceptions, interact at a particular time in space to affect the desire to approach or withdraw from alcohol use. A further example includes the attitudes to heavy alcohol consumption in the Netherlands armed forces personnel [41]. Female Dutch personnel who were asked if too much alcohol was used in their unit responded ‘yes’ at a higher rate (42%) compared to Dutch males (25%), and those that had never deployed responded ‘yes’ to a greater extent (35%) compared to those with previous deployment experience (25%).

In 2002 the British army reported that 80% of violent crime within the army was alcohol related [7]. Also, heavy alcohol consumption was found to be an independent risk factor for the perpetration of spouse abuse among male, enlisted US army soldiers [3]. This is not only a welfare and duty of care issue for service personnel and their dependents, but also possesses disciplinary consequences for anti-social behaviour that could impact personnel in both the short-term (e.g., fines, loss of privileges, or military incarceration) and long-term (e.g., discharge from the armed forces). A study into the transition back to civilian life for military personnel who were discharged from the UK armed forces after spending time in a corrective military training establishment found that alcohol abuse/dependence was a marker for poorer outcomes and disadvantage at follow-up [42]. Furthermore, as previously cited, alcohol impairment contributes to accidents, injuries and the premature death of military personnel [1]-[2];[43]. Finally, alcohol consumption co-varies with other risk-taking and risk-related health behaviours, and has been investigated in military samples, e.g., gambling [32], smoking [13];[18];[44], driving [22], sexual behaviour [45] and illicit drug use [18];[46].

Although the impact on manpower numbers for individual alcohol-related risk factors (e.g., violence, accidents, injuries, poor health) may appear minimal, their cumulative impact may be potentially larger, which reinforces the need to maximise personnel who are fit for task. Furthermore, during deployments, reductions in manpower brought about by battlefield causalities/fatalities and Disease and Non-Battle Injuries (DNBI) will reduce operational manpower further [47]. Therefore, when one considers current levels of operational tempo and the numbers of personnel unfit to deploy, then the relationship between operational and non-operational health and force sustainability becomes increasingly apparent.

4.7 SUMMARY

In summary, risky alcohol consumption has been shown to exist across most aspects of military life. Although it is generally comparable to certain civilian populations for age and gender (i.e., predominantly seen in young, single males) the military appear to ‘push the envelope’ further than their civilian peers, especially for HED and heavy alcohol consumption. This supports the case for generalised high levels of risky alcohol use within the military, and has been specifically reported in the UK armed forces [6]-[8];[16]. However, methodological issues, such as sample populations, different survey measurements, differing definitions of heavy alcohol use and HED, and the reporting of statistical data, confuse the accurate comparison between pan-military and military-civilian populations. Additionally, the risky use of alcohol plays a part in the mental, physical and psychological health outcomes associated with combat exposure and the deployment experience; but also in non-deployed samples. Despite the lack of longitudinal, prospective research across the deployment cycle (pre-, during, post-), there is research to support the concerns and implications of risky alcohol use for pre-deployment readiness, post-deployment readjustment, and its persistent use for long-term health and force sustainability; finally, future alcohol-related research in the military needs to consider a range of demographic, contextual and behavioural factors, which would benefit from the use of both quantitative and qualitative collection methods.

4.8 REFERENCES

[1] Bell, N.S., Amoroso, P.J. and Wegman, D.H., et al. Proposed explanations for excess injury among veterans of the Persian Gulf War and a call for greater attention from policymakers and researchers. 2001 Injury Prev 2001; 7: 4-9.

[2] Garvey-Wilson, G., Lange, J.L. and Brundage, J.F., et al. Behavioural, demographic, and prior morbidity risk factors for accidental death among men: A case-control study of soldiers. Prev Med 2003; 36: 124-30.

[3] Bell, N.S., Harford, T. and McCarroll, J.E., et al. Drinking and spouse abuse among US army soldiers. Alc Clin Exp Res 2004; 28: 1890-7.

[4] Ballweg, J.A. and Li, L. Comparison of health habits of military personnel with civilian populations. Pub Health Report 1989; 104: 498-509.

[5] Bray, R.M., Marsden, M.E. and Peterson, M.R. Standardised comparisons of the use of alcohol, drugs, and cigarettes among military personnel and civilians. Am J Pub Health 1991; 81: 865-9.

[6] Bray, R.M., Hourani, L.L. and Olmsted, K.L.R., et al. Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel: A Component of the Defense Lifestyle Assessment Program. Research Triangle Park, NC: RTI International, 2005.

[7] Fear, N.T., Iversen, A. and Meltzer, H., et al. Patterns of drinking in the UK Armed Forces. Addiction 2007; 102: 1749-59.

[8] Henderson, A., Langston, V. and Greenberg, N. Alcohol misuse in the Royal Navy. Occ Med 2009; 59: 25-31.

[9] Hooper, R., Rona, R.J., Jones, M., et al. Cigarette and alcohol use in the UK Armed Forces, and their association with combat exposures: A prospective study. Add Behav 2008; 33: 1067-71.

[10] Polich, J.M. Epidemiology of alcohol abuse in military and civilian populations. Am J Pub Health 1981; 71: 1125-32.

[11] Benjamin, K.L., Bell, N.S. and Hollander, I.E. A historical look at alcohol abuse trends in army and civilian populations, 1980-1995. Mil Med 2007; 172: 950-5.

[12] Wallace, A.E., Wallace, A. and Weeks, W.B. The US military as a natural experiment: Changes in drinking age, military environment, and later alcohol treatment episodes among veterans. Mil Med 2008; 173: 619-25.

[13] Iversen, A., Waterdrinker, A. and Fear, N., et al. Factors associated with heavy alcohol consumption in the UK Armed Forces: data from a health survey of Gulf, Bosnia, and Era veterans. Mil Med 1997; 172: 956-61.

[14] Federman, E.B., Bray, R. and Kroutil, L.A. Relationships between substance use and recent deployments among women and men in the military. Mil Psych 2000; 12: 205-20.

[15] Williams, J.O., Bell, N.S. and Amoroso, P.J. Drinking and other risk-taking behaviours of enlisted male soldiers in the US Army. Work 2002; 18: 141-50.

[16] Verrall, N.G. The role of risk in the health behaviours of military personnel in the UK Armed Forces: Final customer report. DSTL/CR33456. Porton Down, Wiltshire, UK: Defence Science and Technology Laboratory, 2009.

[17] NATO HFM RTG-120. (2008). Multinational Military Operations and Intercultural Factors.

[18] Moussas, G., Tzemos, L. and Pavlopoulos, V., et al. Alcohol use and abuse in training conscripts of the Hellenic navy. Ann Gen Psych 2006, Article 21.

[19] Ames, G.M., Cunradi, C.B. and Moore, R.S. Alcohol, tobacco, and drug use among young adults prior to entering the military. Prev Science 2002; 3: 135-44.

[20] Taylor, J.E. Alcohol use and misuse among air force recruits. Diss Abstr Int: Sci & Eng 2004; 65:1565.

[21] Hurtado, S.L., Trent, L.K. and Frack, S.A. Relationship among changes in health behaviors in a six-year US Navy cohort: Report No. 97-23. San Diego, CA: Naval Health Research Center, 1997.

[22] Gutierrez, C.A., Blume, A.W. and Schmaling, K., et al. Predictors of aversive alcohol consequences in a military sample. Mil Med 2006; 171: 870-4.

[23] Jacobson, I.G., Ryan, M.A. and Hooper, T.I., et al. Alcohol use and alcohol-related problems before and after military combat deployment. J Am Med Assoc 2008; 300: 663-75.

[24] Calhoun, P.S., Elter, J.R. and Jones, E.R., et al. Hazardous alcohol use and receipt of risk-reduction counselling among US veterans of the wars in Iraq and Afghanistan. J Clin Psych 2008; 69: 1686-93.

[25] Ferrier-Auerbach, A.G., Kehle, S.M. and Erbes, C.R., et al. Predictors of alcohol use prior to deployment in National Guard soldiers. Add Behav 2009; 34: 625-31.

[26] Killgore, W.D.S., Cotting, D.I. and Thomas, J.L., et al. Post-combat invincibility: Violent combat experiences are associated with increased risk-taking propensity following deployment. J Psych Res 2008; 42: 1112-21.

[27] Browne, T., Iversen, A. and Hull, L., et al. How do experiences in Iraq affect alcohol use among male UK armed forces personnel? Occ Environ Med 2007; 65: 628-633.

[28] Rona, R., Fear, N.T. and Hull, L., et al. Mental health consequences of overstretch in the UK armed forces: first phase of a cohort study. Brit Med J 2007; 335: 603-9.

[29] Rona, R., Fear, N.T. and Hull, L., et al. Women in novel occupational roles: mental health trends in UK Armed Forces. Int J Epidem 2007; 36: 319-26.

[30] Zuckerman, M. Behavioral Expressions and Biosocial Bases of Sensation Seeking. Cambridge, UK: Cambridge University Press, 1994.

[31] Zuckerman, M. Sensation Seeking and Risky Behavior. Washington, DC: American Psychological Association, 2007.

[32] Steenbergh, T.A., Whelan, J.P. and Meyers, A.W., et al. Gambling and health risk-taking behaviour in a military sample. Mil Med 2008; 173: 452-9.

[33] Iversen, A., Dyson, C. and Smith, N., et al. “Goodbye and good luck”: the mental health needs and treatment experiences of British ex-service personnel. Brit J Psych 2005; 186: 480-6.

[34] Bremner, J.D., Southwick, S.M. and Darnell, A., et al. Chronic PTSD in Vietnam combat veterans: course of illness and substance abuse. Am J Psych 1996; 153: 369-75.

[35] Savarese, V.W., Suvak, M.K. and King, L.A., et al. Relationship among alcohol use, hyperarousal, and marital abuse and violence in Vietnam veterans. J Traum Stress 2001; 14: 717-32.

[36] Shipherd, J.C., Stafford, J. and Tanner, L.R. Predicting alcohol and drug abuse in Persian Gulf war veterans: what role do PTSD symptoms play? Add Behav 2005; 30: 595-9.

[37] Shipherd, J.C., Stafford, J. and Tanner, L.R. Predicting alcohol and drug abuse in Persian Gulf war veterans: what role do PTSD symptoms play? Add Behav 2005; 30: 595-9.

[38] Hoge, C.W., Castro, C.A. and Messer, S.C., et al. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. New Eng J Med 2004; 351: 13-22.

[39] Barker, C.T. The alcohol hangover and its potential impact on the UK Armed Forces: A review of the literature on post-alcohol impairment. JRAMC 2004; 150: 168-74.

[40] Dolan, C.A., Adler, A.B. and Thomas, J.L., et al. Operations tempo and soldier health: The moderating effect of wellness behaviour. Mil Psych 2005; 17:157-174.

[41] Meijer, M. and Verrall, N.G. Alcohol use and military performance. Poster presented at the NATO HFM-181/RSY Conference on 'Human Performance Enhancement for NATO Military Operations' (Bulgaria, October 2009).

[42] van Staden, L., Fear, N.T. and Iversen, A.C., et al. Transition back into civilian life: A study of personnel leaving the UK armed forces via 'military prison'. Mil Med 2007; 172: 925-30.

[43] Howland, J., Bell, N.S. and Hollander, I.E. Causes, types and severity of injury among army soldiers hospitalised with alcohol comorbidity. Addiction 2007; 102: 1411-20.

[44] Deuster, P.A., Sridhar, A. and Becker, W.J., et al. Health Assessment of US Army Rangers. Mil Med 2003; 168: 57-62.

[45] Thompson, J.C., Kao, T.C. and Thomas, R.J. The relationship between alcohol use and risk-taking sexual behaviours in a large behavioural sample. Prev Med 2005; 41: 247-252.

[46] Bachman, J.G., Freedman-Doan, P. and O'Malley, P.M., et al. Changing patterns of drug use among US military recruits before and after enlistment. Am J Pub Health 1999; 89: 672-7.

[47] Skeehan, C.D., Tribble, D.R. and Sanders, J.W., et al. Nonbattle injury among deployed troops: An epidemiologic study. Mil Med 2009; 174: 1256-1262.

Chapter 5 – RISKY DRIVING BEHAVIOUR

by

Mark A. ZAMORSKI, MD (CAN) and Amanda M. KELLEY, PhD (USA)

ABSTRACT

Road Traffic Accidents (RTAs) are leading causes of death and serious injury in military organizations, both in garrison and on operations. A broad range of risky driving behaviours contribute to RTAs, so preventing or changing these offers promise for accident prevention. Research from the Vietnam War and the 1990 – 1991 Persian Gulf War has shown a consistently higher risk of post-deployment RTA death in those who deployed in support of these conflicts relative to their non-deployed peers, particularly in the first years after return. Analysis of these RTA deaths implicates a broad range of disproportionate risky driving behaviours, such as drinking and driving and speeding. Cross-sectional surveys of driving behaviours also show an association between previous deployment and risky driving. A number of factors could plausibly contribute to this link, including methodological issues, drug and alcohol use, failure to adapt combat driving behaviours to the home environment, distress and mental disorders, suicidal intent, sleep disturbance, neurocognitive deficits due to traumatic brain injuries or toxic exposures, and changes in risk psychology variables related to deployment experiences. None of these factors have been convincingly confirmed or refuted through research, though substantial mediation by traumatic brain injury, neurotoxicity, or suicidal behaviour masquerading as an RTA is unlikely. In contrast, post-deployment distress and mental disorders could serve as a single, unifying explanation for all of the other plausible mechanisms. Development of specific interventions to mitigate post-deployment risky driving hinges upon a deeper understanding of which of these factors mediate the deployment-increased related risk.

5.1 PUBLIC HEALTH SIGNIFICANCE OF ROAD TRAFFIC ACCIDENTS IN MILITARY ORGANIZATIONS

Road Traffic Accidents (RTAs) are leading causes of death in military populations, even in times of war [1]-[5]. They are also common causes of death or serious injury on deployments, be they combat deployments [3];[6] or peacekeeping deployments [7]. RTAs also contribute heavily to serious injuries [8], with their attendant consequences in terms of health care costs, loss of productivity, and impaired well-being. One person's driving behaviour can obviously result in death or serious injuries to others (passengers, pedestrians, other drivers, etc.), triggering a special duty on the part of military organizations to attenuate any occupationally-related increased risks in RTAs. In addition, many military personnel drive as part of their military work, both on deployment and in garrison. Work-related RTAs can put other military personnel or non-combatants at risk, and expensive or scarce equipment can be damaged in on-duty RTAs [9]. For all of these reasons, military organizations take an active interest in preventing RTA in military personnel.

5.2 RISKY DRIVING BEHAVIOURS

A broad range of driver behaviours contribute to RTAs or to injury severity resulting from them [10]-[12]:

- Alcohol and drug use;
- Speeding;
- Frequent or rapid lane changes;
- Failing to signal;

- Tailgating;
- Motorcycle use;
- Failing to use a helmet on a motorcycle;
- Failing to wear a seatbelt;
- Driving while drowsy; and
- Engaging in distracting behaviour (e.g., cell phone use) [13];[14].

Many of these risk factors have also been confirmed in military populations [9];[15].

5.3 ENVIRONMENTAL FACTORS THAT CONTRIBUTE TO ROAD TRAFFIC ACCIDENTS

Environmental factors also contribute to RTAs [12]: Road design and maintenance, vehicle characteristics, weather and climate, regulation, law enforcement practices, macroeconomics, etc., can all influence whether people drive at all, how much they drive, where the drive, when they drive, and of course *how* they drive. That is, the physical/social environment directly contributes to RTAs, and it also can interact with driver behaviour to influence RTAs and related deaths/injuries [12].

5.4 THE EFFECT OF MILITARY DEPLOYMENTS ON RISKY DRIVING BEHAVIOURS

5.4.1 Different Approaches to Studying the Effects of Military Deployments on Risky Driving

The influence of deployment on RTAs has been explored using both health surveillance statistics (for both fatal and non-fatal accidents) and driver behaviour surveys.

5.4.1.1 Health Surveillance Studies

Accident surveillance data can provide compelling evidence of ultimate outcome of interest, and it can document the absolute public health impact of deployment-related changes in RTA patterns. Accident surveillance statistics may also provide insight into some driver behaviours (e.g., speeding, seatbelt use, fatigue, alcohol and drug use) but it can't provide any sense of how habitual these behaviours are. Unfortunately, the cause of death recorded on death certificates grossly underestimates the contribution of alcohol to RTA deaths [16].

5.4.1.2 Survey Studies

Surveys are most useful when it can be established that particular driver behaviours are causally linked with the risk of serious RTAs. The complementary value of the survey approach is several-fold: First, risky driving behaviours are far more prevalent than serious accidents, resulting in greater statistical power. Collecting survey data is feasible before and after deployment, removing many important sources of bias. Surveys also permit the testing of certain causal hypotheses, particularly those that relate to the psychological processes that underlie risky driving behaviour. This level of detail is seldom available in surveillance studies. Finally, survey data can provide early evidence that interventions designed to limit the risk of RTAs are working.

5.4.2 Civilian-Military Comparisons

Civil-military comparisons could be used to explore the possible associations between military service and either accident rates or driving behaviours reported on surveys; such comparisons have been used to explore the potential link between military service and suicide [17] and mental health problems [18];[19]. These sorts of comparisons require careful adjustment for potential confounding factors: Many factors other than deployment-related changes in driving behaviour that might explain any observed differences. It is plausible, for example, that the risk taking propensity of individuals who choose to serve in the military is different from that in the general population [20], and accident surveillance data never capture this dimension well enough to permit the necessary adjustments. In any case, only a single mortality surveillance study exploring this issue could be identified [21]; this study showed that US Vietnam veterans had a slightly higher risk of fatal RTA than their general population counterparts of the same age and sex during the first five years after return from deployment (but not thereafter).

5.4.3 Studies on the Association of Deployment with Road Traffic Accidents

A number of studies have convincingly demonstrated that previously-deployed service members have a significantly elevated risk of fatal RTAs compared to their non-deployed military peers. The two conflicts that have been studied the most are the Vietnam War [21]-[25] and the 1990 – 1991 Persian Gulf War [26]-[33]. The excess risk is small in absolute terms (e.g., risk ratios of ~1.3 [34], but because RTAs are a leading contributor to death, even a small risk ratio has important public health implications. The risk of some other external causes of death (e.g., poisoning, homicide, suicide) have also been shown to be elevated in Vietnam veterans [21];[25] and those who deployed in the 1990 – 1991 Persian Gulf War [26]; [27];[34]. The increased risk of fatal RTA appears to wane over time [21];[27];[34]. In the Gulf War at least, those in combat occupations had higher rates of RTA death than other military occupations [29].

Data from the Second World War era and the Korean War era have also shown an excess in external causes of death, but only in those who actually deployed to the theatre of operations (cited in [25]).

Exploration of the details of RTA deaths in previously deployed vs. non-deployed cohorts has pointed to a number of differences in the accident circumstances [35]. The deployed cohort had an excess of RTA deaths involving:

- Failure to wear seat belts;
- Failure to use motorcycle helmets;
- Failure to engage in crash avoidance manoeuvres;
- Speeding;
- Alcohol use;
- Single vehicle accidents;
- Collisions with a fixed object;
- Rollovers;
- Ejections from the vehicle;
- Drivers with previous alcohol-related driving infractions; and
- Death within one hour of the accident.

The US military has used surveillance data [36] to explore the temporal relationship of RTA fatalities relative to the deployment cycle. There were 1.5 times as many deaths in the first 30 days after return from

a deployment than at other periods of service. However, this period accounted for only a small minority (3%) of all RTA deaths.

There is also data that the increased propensity to injury after deployments goes beyond RTAs: Gulf War Veterans report more injuries in general on post-war surveys [37], and they appear to be hospitalized more often for physical trauma than their non-deployed peers [38];[39].

5.4.4 Prevalence of Self-Reported Risky Driving Behaviour in Military Organizations

This section summarizes the prevalence of self-reported risky driving behaviours in military personnel.

5.4.4.1 Driving and Alcohol Use

Survey data from the US showed that an important minority of active duty military personnel reported driving after having had too much to drink in the previous 12 months (9% in the Army, 11% in the Navy, 11%, in the Marine Corps, and 7% in the Air Force) [40]. Among heavily combat-exposed US Army personnel surveyed very shortly after their return, 7% reported having driven after having several drinks or having ridden with a driver who had had too much to drink *over the previous 4 weeks.* Recent survey data from Canada [41] showed that 5.5% of Regular Force personnel had driven after having had too much to drink in the previous 12 months; 6.1% reported having been a passenger in a vehicle in which the driver had had too much to drink; these rates appear to be lower than the corresponding civilian population in Canada [41].

5.4.4.2 Seat-Belt and Helmet Use

Data on seatbelt use are more encouraging: 94% of US military personnel reported using seatbelts “always” or “often” [40]; similar rates have been reported in the UK military as part of a cohort study [42]. Of US military personnel who had operated a motorcycle in the previous 12 months, 87% reported using a helmet “always” or “nearly always” [40]. In a UK post-deployment sample, 88% reported using seatbelts “always” or “nearly always” when riding in the front seat [42]. Rear-seat use was less consistent (69%) [43]. Unfortunately, self-reported seatbelt use is known to overestimate actual use relative to studies that involve actual behavioural observation [44].

5.4.4.3 Other Risky Driving Behaviours

Fear et al. [42] reported that 14% of their UK military cohort usually drove more than 20 miles per hour (32 km/hr) over the speed limit on the motorway; Verrall’s [43] post-deployment sample reported this behaviour at similar rates (15%). Verrall [43] also found that 7% reported usually driving more than 10 miles per hour (16 km/hr) over the speed limit in built-up areas. Driving while sleepy is an important risk factor for accidents [45], but published prevalence rates in military populations are limited: Radun [46] found that more than half of Finnish military conscripts reported driving while fatigued in the previous two months and that falling asleep at the wheel was the leading cause of fatal accidents in this population.

5.4.5 Studies on the Association of Deployment and Combat Experiences with Driver Behaviour Reported on Surveys

Only a limited number of studies have explicitly explored the association between previous deployment and risky driving behaviours. In all cases, at least some positive association was found. Fear et al. [42] in the UK found that deployment in the very earliest phase of the Iraq war was an independent risk factor for risky driving, with an adjusted odds ratio of 1.3. Deployment a bit later in the conflict (when the threat level was lower) was not independently associated with risky driving. In the Canadian Forces, deployment

over the previous two years had a very small, univariate association with a health and safety scale that included items on risky driving [47]. This was, however, prior to the CF's widespread involvement in combat operations in Kandahar province. A population-based military survey in the US [48] found that an aggregate outcome of a number of high risk *drinking* behaviours (drinking and driving among them) had a modest, univariate association with lifetime combat exposure.

Killgore et al. [20] studied US Army personnel approximately 3 months after a demanding combat deployment in Iraq. While there was no non-deployed control group, they did show that higher levels of combat exposure had a small, independent association with a scale measuring risk-taking propensity; the scale included risky driving as well as other risky behaviours. However, only specific types of combat exposures had this association, and the association varied somewhat by the type of risk-taking behaviour. The types of combat exposure most consistently associated with risky behaviour were exposure to violent combat, having killed combatants, and having killed "friendlies" or non-combatants.

Longitudinal data on driving behaviour across the deployment cycle is limited to a single study by Verrall [43] on a single UK mechanized brigade deployed to Iraq in 2008. Somewhat surprisingly, seat-belt use and speeding was reported *less* frequently in the post-deployment period relative to the pre-deployment period.

5.5 SUMMARY OF RISKY DRIVING BEHAVIOURS IN THE MILITARY

A broad range of risky driving behaviours are seen in an important minority of military personnel. Risky driving behaviours contribute to RTAs, which in turn represent a heavy burden in terms of serious injuries and mortality. Survey data largely points to an association between combat deployments and risky driving behaviour. The magnitude of this effect is small, and in fact may be undetectable in those with little or no combat exposure. Moreover, there is consistent evidence that this behaviour (and perhaps other unmeasured factors) express themselves in the consistently higher rate of motor vehicle accidents (and other external causes of death) seen at least in the first years after return from at least some deployments (notably the Vietnam War and the 1990 – 1991 Gulf War). In epidemiological terms, the magnitude of this increased mortality risk is small [34], but its public health impact is large in military populations due to the large fraction of all deaths that are due to RTAs [1]-[5].

5.6 POSSIBLE EXPLANATIONS FOR THE ASSOCIATION OF RISKY DRIVING BEHAVIOURS AND MILITARY DEPLOYMENTS

A number of different hypotheses have been proposed to explain the association between deployment and risky driving behaviours/RTA death.

5.6.1 Selection Bias

It is plausible that those who choose to enter military service may **possess** factors (such as lower risk aversion) that may predispose **them** to accidental death. This **hypothesis could be rejected** because most of the modern research compares deployed veterans against their non-deployed peers (e.g., [25];[30];[39].

It is harder to reject out of hand the hypothesis that service members *selected for deployment* might differ in important ways from those who happen not to deploy. Clearly, selection for deployment is not a random event in modern military organizations – important differences in health status between deployers and non-deployers have been demonstrated, even after substantial adjustment for potential confounding factor [49]-[51]; this has been termed the "healthy warrior effect". In addition to being healthier, it is possible that deployers exhibit other, unmeasured individual differences that are associated with risk taking propensity.

5.6.2 Drug and Alcohol Use

As noted elsewhere in this report, deployment has been clearly associated with an increased risk of both hazardous drinking and overt alcohol use disorders. To the extent that these are associated with a substantially increased risk of RTA (particularly *fatal* RTA) [12], it is plausible that alcohol use could mediate the link between deployment and RTA. Indeed, it would be surprising if the clearly increased alcohol use after deployment did *not* translate into a higher risk of RTA, given the strong association between heavy drinking and RTA deaths. As noted earlier, survey data has shown that UK service members who had deployed to Iraq more often reported having driven under the influence than their non-deployed peers [42].

The excess of RTA deaths in the early post-deployment period [36] mirrors the higher rates of risky drinking seen over the same period [40]. Detailed evaluation of the circumstances of accidents of Gulf War Veterans offers support to this hypothesis: Fatal crashes with GWVs were somewhat more likely to have involved alcohol than those involving their non-deployed peers [35];[52]. They were also more likely to have had a previous conviction for driving under the influence [35];[52].

Illicit drug use has also been reported as a consequence of military deployments, particularly in Vietnam veterans [53]. Marijuana use is prevalent among men of military age and has been shown to be inconsistently associated with RTAs [54];[55]; the negative effects of marijuana and alcohol appear to be synergistic [54].

In other words, there is a range of evidence that suggests that at alcohol use is at least a partial mediator of the link between combat deployments and RTA fatalities. A connection with illicit drug use is also plausible, but data are sparse. No studies directly addressed whether the observed increase in RTA is *fully* accounted for by hazardous drinking or alcohol use disorders.

5.6.3 Failure to Adapt Combat Driving Habits to the Home Environment

Driving in today's combat environment in Southwest Asia results in a variety of potentially adaptive changes in driving behaviour [56] that are intended to minimize the risk of improvised explosive devices, which are of course the weapon of choice of the insurgents. These adaptations include speeding, straddling the centre line, making unpredictable turns or lane changes, running red lights, etc. In fact, soldiers receive combat driving training to prepare them for these challenges.

Even in theatre, these driving behaviours must offer both risks and benefits, but once home, these "adaptations" are no longer so adaptive: They only present a significantly increased risk of RTA. For this reason, the US Army offers mental health training at the time of re-deployment [57] that is intended to sensitize personnel to the need to change these behaviours once they are home.

There is abundant anecdotal evidence that these combat driving behaviours do persist in at least some personnel [58]. In a survey of National Guard personnel who had returned form a combat deployment, Stern et al. [58] found that in the preceding 30 days, 25% had straddled the centre line or driven into oncoming traffic, 25% had run a stop sign, and 10% had driven erratically in a tunnel or on an overpass. Part of this persistence of combat driving must be simply an ingrained habit; many driving behaviours have a reflexive/habitual element. If so, it is somewhat surprising that personnel who drove in theatre are about as likely to report the persistence of these behaviours as those who didn't drive [58].

In a clinical sample of veterans of a number of conflicts who were in residential treatment for PTSD, Kuhn et al. [59] showed that lifetime aggressive and unsafe driving behaviours were highly prevalent. Interestingly, veterans of the current conflicts in Southwest Asia reported these at higher rates than veterans of previous conflicts, raising the possibility that the unique driving-related hazards of the current conflicts may be a contributing factor to these behaviours. If that is true, then other explanations will need

to be invoked to explain the elevated risk of RTA deaths in veterans of other conflicts. In other words, failure to adapt the unique combat driving behaviours used in the current conflicts cannot be the *only* explanation for deployment-related risky driving behaviour and excess RTA mortality.

An alternative explanation for the persistence of combat behaviours is post-combat anxiety, which is discussed below.

5.6.4 Anxiety and Depression

Anxiety is a common post-deployment symptom, particularly after combat deployments [60]. This can take the form of PTSD, other anxiety disorders, an adjustment disorder, a sub-threshold condition, a symptom of another disorder (e.g., depression), or simply a normal reaction to the challenges of reintegration after a difficult deployment. High levels of anxiety can degrade driving performance through anxiety-related performance deficits (e.g., having trouble finding the right lane), exaggerated safety behaviours (e.g., repeatedly looking at in the rear-view mirror), and anxiety-related anger/aggressivity (e.g., tailgating a driver that triggered anxiety) [61]. In theatre, anxieties about seatbelt use lead to widespread non-compliance with the official requirement to wear seatbelts at all times; personnel are concerned about being able to exit the vehicle or access their weapon in case of an emergency [62]. This may a military example of exaggerated safety behaviour.

In qualitative work with US National Guard personnel after a demanding combat deployment, Stern et al. [58] found that persistent, irrational driving-related anxieties were common. That is, personnel had feelings of anxiety related to non-existent threats such as IEDs. Survey research showed that these anxieties were strongly associated with risky combat driving behaviour in the post-deployment period. Risky driving behaviour declined over the post-deployment period, though the anxieties persisted. Other anxiety-related driving deficits are possible, too. Anxiety disorders and depression can interfere with sleep, leading to sleep deficits and impaired driving. Depression, when severe, can cause psychomotor retardation that could slow reaction time. Through these and other mechanisms, mental disorders can result in neurocognitive impairments such as impaired concentration, which could increase the risk of RTA. Finally, medications commonly given for mental disorders have been associated with an increased risk of accidents [63]-[65]; some of this increased risk comes from the underlying conditions and some appears to be an effect of the medication itself [66].

There are at least two other potential mechanisms for the influence of anxiety on risky driving: First, the exhilaration of some risky driving experiences could serve as a simple distraction for some people. In addition, emotional numbing is a cardinal symptom of PTSD, and some individuals who experience this will go to extremes (including deliberate self-harm) to escape this.

The apparent association of combat exposure and risky driving behaviour [67] is entirely consistent with the hypothesis that some of the association is mediated by mental disorders, which also are strongly correlated with combat exposure [60];[68];[69]. That is, combat exposure leads to mental disorders that lead to risky driving, which in turn leads to RTAs.

Thus, there is evidence that anxiety, and perhaps depression, likely mediates some of the association between deployments and RTAs. Some of this effect may be further mediated by psychiatric medications. Unfortunately, there are a number of other potential ways in which mental disorders might lead to risky driving behaviours, so future research will need to explore each of these.

5.6.5 Suicide and Deliberate Self-Harm

Deployment (particularly those involving combat or exposure to atrocities) is commonly perceived to be an important risk factor for suicide. This is certainly plausible: Combat or exposure to atrocities can result

in mental disorders [70] and to suicidal ideation [71]. Nevertheless, a number of studies have failed to confirm a consistently increased risk of suicide in previously deployed personnel [17].

Could some of the excess risk of post-deployment RTAs thus represent suicide? Some of the characteristics of the RTA fatalities in the post-deployment population discussed above could point in this direction (e.g., the excess of single car accidents, collisions with a fixed object). However, there is no excess of single-*occupant* RTA deaths (that is, those involving a driver and no passengers) [35]. In addition, careful review of external causes of death recorded on death certificates in Western countries shows little misclassification, and suicide using a motor vehicle is an uncommon means in industrialized countries [72]-[80]. One would have to hypothesize that misclassification is for some reason far more likely in previously deployed personnel than in non-deployed personnel. Hence, most evidence points away from the hypothesis that the excess of RTA deaths in previously-deployed personnel is due to misclassification of suicides as RTAs.

5.6.6 Sleep Disturbance

A number of factors contribute to motor vehicle accidents, including fatigue and sleepiness. Sleep disturbance is another common symptom of the post-deployment period [81]. It can be a manifestation of an underlying psychiatric disorder (such as depression or PTSD), or it can occur as a more independent problem or symptom [81]. Even modest amounts of sleep deprivation result in significant driving impairments that are comparable in magnitude to driving under the influence of alcohol [45].

For these reasons, sleepy driving is second only to alcohol as a contributor to RTA fatalities [45]; numerous neuropsychological changes contribute to this increased accident risk [82]. The U.S. Army Combat Readiness/Safety Center (CRC) reported fatigue to be one of the leading causes of off-duty ground accidents [83]. The CRC also reports that the majority of off-duty fatigue-related accidents occur between 23:59 and 04:00 hours. No experimental evidence specific to military personnel and fatigue-related accidents was found in searches of published literature and unpublished technical reports; however, a large number of driver fatigue studies focus on shift work employees such as nurses and those who operate motor vehicles for extended periods of time such as long-haul truck drivers and has shown that driver fatigue is a significant risk factor for these populations (e.g., [84]-[86]).

It is logical to infer a positive relationship between driver fatigue and crash risk but the strength of this relationship is unclear. In a systematic review of epidemiological studies of fatigue and motor vehicle crashes, Connor et al. [87] reported that few well-designed research studies of the effect of fatigue on motor vehicle crash risk exist in the literature. They found that some studies provided evidence suggesting a positive relationship between fatigue and crash risk but no evidence of the strength of that relationship. Given the infrequency of quality studies on the topic, they concluded that the existing literature does not provide evidence of a strong or even reliable relationship between motor vehicle crash risk and measures of fatigue with the exception of sleep apnoea. That understood, other lines of evidence strongly support such a relationship (e.g., driving simulator studies on sleep-deprived or fatigued individuals, studies of the effect of sleep deprivation on neurocognitive functions known to be important to driving, the self-reports of accident survivors who report having fallen asleep at the wheel, and accident investigations that strongly suggest sleepiness as the key factor in the accident [46]).

Finally, as noted above, hypnotics often given for sleep problems can also degrade driving performance. Hence, it is plausible that at least some of the effect of deployment on RTA fatalities is mediated by sleep disturbance, some of which is in turn mediated by mental disorders.

5.6.7 Anger/Aggressivity

Anger and aggressivity is another common complaint during the post-deployment period [88];[89], and it can be the consequence of an underlying mental disorder (notably PTSD [90]-[93], a reaction to stressors,

or simply a personal disposition. Anger can trigger aggressive driving behaviours [94], which in turn can lead to accidents [95]. So again, mediation of deployment-related accident risk through anger/aggressivity is plausible (and may be driven by distress and mental disorders), though there are no studies that have explicitly explored this possibility.

5.6.8 Neurotoxicity Related to Deployment-Specific Exposures

Exposure to potential neurotoxins such as insecticides, chemical warfare agents, and pyridostigmine bromide have been suggested as a cause of Gulf War Illnesses [96]. Indeed, fatigue and neurocognitive complaints are among the most common in GWVs [97], and these might lead to an increased risk for RTA. Two studies have has explored this hypothesis directly: Bullman [98] and Gackstetter [32] did not find any increase in the risk of RTA in GWVs exposed to low levels of chemical warfare agents, and Macfarlane [31] found that self-reported exposure to potential neurotoxins did not increase the risk of external causes of death. Hence, there is little evidence to support this hypothesis.

5.6.9 Traumatic Brain Injury

A significant proportion of personnel deployed during the current conflicts have been exposed to Traumatic Brain Injury (TBI), most of which are blast-related and most of which fall into the mild TBI (mTBI) category [99]-[102]. More severe forms of TBI are associated with a high risk neurocognitive deficits that can impair driving abilities [56];[103], but these are uncommon enough [104] that these cannot be driving population-wide deployment-related changes in driving behaviour or RTA mortality.

Fatigue is one of the most commonly reported symptoms among individuals who have had a traumatic brain injury (TBI) [105]. In a longitudinal study by Bushnik et al. [106], participants reported the highest levels of fatigue within 6 months post-injury and showed a pattern of decline in fatigue over the course of a year. Sleep disturbance is another common complaint following TBI [107];[108]. Depression also occurs commonly after TBI [109], even in athletes who presumably are at low risk for psychological trauma after their injury. As noted above, depression is a plausible driver of risky driving behaviour.

The prevalence and origin of long-term symptoms and deficits after mTBI remain controversial. Data from the sports literature [110] clearly shows that virtually all concussed athletes recover completely over the days and weeks after their injury. Data from civilian victims of accidents and assaults [111] tell a more complicated story, with an important minority complaining of persistent symptoms, though objective deficits are distinctly uncommon. In civilian mTBI cases, persistent symptoms are associated with psychosocial factors as opposed to the characteristics of the physical injury itself [112]-[115].

In a recent study at RAND Corporation., an estimated 19.5% of US Soldiers returning from Iraq and Afghanistan have a probable TBI [102]. Those with TBI also tend to report increased sleep disturbances and daytime sleepiness. Thus, indirectly, Soldiers returning from deployment have an increased risk of experiencing fatigue.

Data from military personnel with deployment-related mTBI are accumulating rapidly. These data have consistently shown that persistent symptoms are not uncommon, but they have a much tighter relationship with mental disorders and distress than they do with the after-effects of mechanical brain injury [99];[100];[116]-[120]. Neuropsychological testing has failed to show specific deficits in mTBI-affected personnel in the post-deployment period [118];[121];[122]. Where deficits are seen, they tend to be mild and fully accounted for by co-morbid mental disorders and distress [116]. It thus seems unlikely that TBI is a major mediator of the link between deployment and RTAs.

5.6.10 Risk Tolerance, Sensation-Seeking, and Impulsivity

As mentioned earlier in this report, personality traits such as risk tolerance [123], sensation-seeking [124], and impulsivity [123] are consistently related to risky driving [125] and to a broad range of other health risk behaviours. These traits could explain why such a broad range of risky driving behaviours appears to be influenced by deployment (as discussed above). Many of these traits relate to individual differences in how individuals evaluate and react to risks. Key traits include impulsivity, risk tolerance, and sensation seeking [125]. These traits could be relevant to the issue of deployment and health risk behaviours if:

1) They are a source of bias in research (alluded to above); and
2) If they *change* in response to the experience of deployment.

There is evidence from some populations that these risk-related traits are largely stable over time [126]; [127], at least in civilians exposed to everyday life experience. But combat is not an everyday experience, so it is conceivable that it could alter the way one perceives and evaluates risks. Anecdotally, there is the impression that combat turns soldiers into “adrenaline junkies” who yearn for the “high” they experienced in combat. Post-combat invincibility [20] has been proposed as one potential mechanism for increased post-deployment risk toleration. Indeed, programs have been developed to give previously deployed personnel an opportunity to quench their thirst for excitement in less risky ways, such as through organized adventure training activities [128]. Despite the intuitive appeal of this line of thinking and the known association of sensation-seeking with risky driving [129], there is no hard data to support the assertion that the experience of combat results in significant changes in risk psychology.

Impulsivity is a known risk factor for general risk-taking [130];[131], risky driving [123], and RTAs [132]. As such, changes in impulsivity could explain the increased risk of RTAs after deployment. Several mechanisms are possible: Combat requires split-second reactions, so it is conceivable that that tendency could carry over into the post-deployment period. Indeed, there is evidence that reaction time is indeed decreased in combat veterans [133]. That said, decreases in reaction time may have both positive and negative impacts on RTAs.

In addition, negative emotions such as anger and anxiety (commonly seen post-deployment) tend to increase impulsivity [134]. Positive emotions (joy, elation, relief) also promote impulsivity [134];[135]; these are understandably common early in the reintegration period [136]. Presumably, this elation is short-lived, so it cannot explain the excess RTA mortality seen for at least several years after return from deployment. Finally, alcohol use (increased post-deployment, as we have seen) obviously tends to increase impulsivity [137]. There is also emerging longitudinal evidence that heavy drinking itself can lead to changes in impulsivity and sensation-seeking in young adults [138]. Hence, a bi-directional causal relationship between impulsivity and heavy alcohol use may exist, and this is a potential mediator of the effect of deployment on health risk behaviours. Finally, sleep deprivation results in increased impulsivity and risk-taking [139]. It is thus possible that post-deployment sleep problems [81] mediate the link between deployment and risk-taking.

The emerging data on the role that driving-related anxieties play in the genesis of risky post-deployment driving behaviour [58] provides an interesting foil for this risk psychology hypothesis: If the anxiety is playing an important role, then the risky driving behaviour is not motivated by a desire for increased excitement or arousal. It is instead an effort (albeit a risky one) to *minimize* arousal by driving in a way that is comforting (though dangerous).

To summarize, it is known that risk psychology variables such as risk tolerance, sensation seeking, and impulsivity are all strong predictors of risky driving behaviour. That much is clear. What is unclear is whether the experience of deployment changes these variables enough to account for the observed deployment-related increase in risky driving. If such a link does exist, distress and mental disorders may be an important mediator of the link between deployment and changes in risk psychology.

5.7 SUMMARY OF DEPLOYMENT AND RISKY DRIVING BEHAVIOURS

RTG-164 found relatively consistent evidence that combat deployments increase risky driving behaviours and that these behaviours contribute to the increased risk of RTA fatalities seen in previously deployed personnel. The literature shows a consistent pattern of stronger effects with more combat and weaker or absent effects with less combat. The limited longitudinal data on risky driving [43] (showing if anything a decrease in risk-taking behaviours post-deployment) may be explained by the more limited combat exposure in the study population, which was in Iraq during a relatively stable time. However, it might also indicate that some of the apparent differences in health risk behaviours in deployed and non-deployed cohorts are due to residual confounding as opposed to a direct or indirect effect of deployments.

Theory and research offer many possible explanations for the link between deployment, risky driving behaviour, and post-deployment RTA deaths. At least some of the excess risk is almost certainly mediated by risky drinking behaviour, but exactly how much is not known. Illicit drug use may also play a role, though likely a smaller one. Prescription drugs used for mental disorders and sleep disturbance can impair driving and probably contribute to motor vehicle accidents, though it is not clear how much of the deployment-related risk for RTAs is due to these. Sleep disturbance itself and anger/aggressivity, either as a manifestation of an underlying mental disorder or as an independent problem, are possible mediators, but hard data on how these influence driving in the post-deployment context is limited. Mediation by anxiety or depression is highly plausible, and changes in mood or affect may exert their influence via many other mediators (e.g., sleep disturbance, impulsivity, drug/alcohol use). It is clear that dangerous combat driving behaviours persist in an important minority for at least some time. However, it is not clear how much of this is due to simple habituation, though there is emerging evidence that anxiety is an important driver of this behaviour in the post-deployment period. Mediation by changes in risk psychology variables such as risk tolerance, sensation-seeking, and impulsivity is possible, but there is as yet no evidence that deployment influences these factors. If there is such an effect, distress and mental disorders may be important mediators of changes in risk psychology. In fact, *all* of the likely mechanisms discussed above could be mediated by distress or mental disorders. Significant mediation of deployment-related risky driving through the effect by traumatic brain injury or neurotoxin exposures is unlikely, as is the possibility that suicides are masquerading as RTA fatalities.

Clearly, more longitudinal research (including research that explores the stability of risk psychology variables) is needed. Future research needs to capture the full range of risky driving behaviours, along with the full range of potential mediators, and it should allow for the possibility that different psychological factors influence different risky driving behaviours [140]. Given the potential centrality of distress and mental disorders to the post-deployment increase in risky driving behaviour, these should be measured carefully, and analysis should explore the extent of mediation by these.

The above discussion should make it clear that driving is a complex (and often essential) activity with a complex series of antecedents. The potential motivations for the broad range of risky driving behaviours are broader still. The discussion above expands the range of possible explanations for deployment-related risky driving beyond those documented in recent reports [20];[42];[56]. It is hoped that this broader perspective will translate into better research projects, which in turn will lead to advancements in terms of the prevention and control of post-deployment mortality due to RTAs. A richer understanding of the mechanisms that mediate the relationship between deployment and fatal RTAs is absolutely essential for the development of reliable counter-measures.

5.8 REFERENCES

[1] Tien, H.C., Acharya, S. and Redelmeier, D.A. Preventing deaths in the Canadian military. Am J Prev Med 2010 March; 38(3):331-9.

[2] Armed Forces Health Surveillance Center. Motor vehicle-related deaths, U.S. armed forces, 2009. Medical Surveillance Monthly Report 2010 March; 17(3):2-5.

[3] Armed Forces Health Surveillance Center. Deaths while on active duty in the U.S. armed forces, 1990 – 2008. Medical Surveillance Monthly Report 2009 May; 16(5):2-6.

[4] Krull, A.R., Jones, B.H., Dellinger, A.M., Yore, M.M. and Amoroso, P.J. Motor vehicle fatalities among men in the U.S. Army from 1980 to 1997. Mil Med 2004 November; 169(11):926-31.

[5] Defence Analytical Services Agency. Deaths in the UK regular armed forces, 2006. Bath, UK: Ministry of Defence (UK); 2007.

[6] Hauret, K.G., Taylor, B.J., Clemmons, N.S., Block, S.R. and Jones, B.H. Frequency and causes of nonbattle injuries air evacuated from operations Iraqi freedom and enduring freedom, U.S. Army, 2001 – 2006. Am J Prev Med 2010 January; 38(1 Suppl):S94-107.

[7] Appenzeller, G.N. Injury patterns in peacekeeping missions: the Kosovo experience. Mil Med 2004 March; 169(3):187-91.

[8] Bhalla, K. Incidence of road injuries in the United States. Global Burden of Road Injuries Web Site 2010 May 5; Available from: URL: http://roadinjuries.globalburdenofinjuries.org/usa.

[9] Krahl, P.L., Jankosky, C.J., Thomas, R.J. and Hooper, T.I. Systematic review of military motor vehicle crash-related injuries. Am J Prev Med 2010 January; 38(1 Suppl):S189-S196.

[10] Blows, S., Ameratunga, S., Ivers, R.Q., Lo, S.K. and Norton, R. Risky driving habits and motor vehicle driver injury. Accid Anal Prev 2005 July; 37(4):619-24.

[11] Petridou, E. and Moustaki, M. Human factors in the causation of road traffic crashes. Eur J Epidemiol 2000; 16(9):819-26.

[12] World report on road traffic injury prevention. Geneva: World Health Organization; 2004.

[13] McEvoy, S.P., Stevenson, M.R. and Woodward, M. The impact of driver distraction on road safety: results from a representative survey in two Australian states. Inj Prev 2006 August; 12(4):242-7.

[14] McEvoy, S.P., Stevenson, M.R., McCartt, A.T., Woodward, M., Haworth, C. and Palamara, P. et al. Role of mobile phones in motor vehicle crashes resulting in hospital attendance: a case-crossover study. BMJ 2005 August; 331(7514):428.

[15] Stenbacka, M., Leifman, A., Dalal, K. and Jansson, B. Early predictors of injury mortality among Swedish conscripts: a 35-year cohort study. Accid Anal Prev 2011 January; 43(1):228-34.

[16] Pollock, D.A., Boyle, C.A., DeStefano, F., Moyer, L.A. and Kirk, M.L. Underreporting of alcohol-related mortality on death certificates of young US Army veterans. JAMA 1987 July 17; 258(3): 345-8.

[17] Zamorski, M.A. Suicide prevention in military organizations. Int Rev Psychiatry 2011 April; 23(2):173-80.

[18] Zamorski, M.A., Uppal, S., Boddam, R. and Gendron, F. The prevalence of mental health problems in the Canadian armed forces: comparison with the Canadian general population. 2006. Poster presented at the Canadian Psychiatric Association Annual Meeting, Toronto, Ontario, Canada.

[19] Belik, S.L., Stein, M.B., Asmundson, G.J. and Sareen, J. Are Canadian soldiers more likely to have suicidal ideation and suicide attempts than Canadian civilians? Am J Epidemiol 2010 December 1; 172(11):1250-8.

[20] Killgore, W.D., Cotting, D.I., Thomas, J.L., Cox, A.L., McGurk, D. and Vo, A.H. et al. Post-combat invincibility: Violent combat experiences are associated with increased risk-taking propensity following deployment. J Psychiatr Res 2008 February.

[21] Boehmer, T.K., Flanders, W.D., McGeehin, M.A., Boyle, C. and Barrett, D.H. Postservice mortality in Vietnam veterans: 30-year follow-up. Arch Intern Med 2004 September 27; 164(17):1908-16.

[22] Fett, M.J., Adena, M.A., Cobbin, D.M. and Dunn, M. Mortality among Australian conscripts of the Vietnam conflict era. I. Death from all causes. Am J Epidemiol 1987 May; 125(5):869-77.

[23] Fett, M.J., Dunn, M., Adena, M.A., O'Toole, B.I. and Forcier, L. Australian veterans health studies: the mortality report – part I. Canberra, Australia: Australian Government Publishing Service; 1984.

[24] Boyle, C.A. and Decoufle, P. Postdischarge mortality from suicide and motor-vehicle injuries among Vietnam-era veterans. New England Journal of Medicine 1987 August; 317(8):506-7.

[25] Postservice mortality among Vietnam veterans. MMWR Morb Mortal Wkly Rep 1987 February 13; 36(5):61-4.

[26] Kang, H.K. and Bullman, T.A. Mortality among U.S. veterans of the Persian Gulf War. New England Journal of Medicine 1996 November 14; 335(20):1498-504.

[27] Kang, H.K. and Bullman, T.A. Mortality among US veterans of the Persian Gulf War: 7-year follow-up. Am J Epidemiol 2001 September 1; 154(5):399-405.

[28] Hooper, T.I., DeBakey, S.F., Lincoln, A., Kang, H.K., Cowan, D.N. and Gackstetter, G.D. Leveraging existing databases to study vehicle crashes in a combat occupational cohort: epidemiologic methods. Am J Ind Med 2005 August; 48(2):118-27.

[29] Hooper, T.I., DeBakey, S.F., Bellis, K.S., Kang, H.K., Cowan, D.N. and Lincoln, A.E. et al. Understanding the effect of deployment on the risk of fatal motor vehicle crashes: a nested case-control study of fatalities in Gulf War era veterans, 1991 – 1995. Accid Anal Prev 2006 May; 38(3):518-25.

[30] Macfarlane, G.J., Thomas, E. and Cherry, N. Mortality among UK Gulf War veterans. Lancet 2000 July 1; 356(9223):17-21.

[31] Macfarlane, G.J., Hotopf, M., Maconochie, N., Blatchley, N., Richards, A. and Lunt, M. Long-term mortality amongst Gulf War Veterans: is there a relationship with experiences during deployment and subsequent morbidity? Int J Epidemiol 2005 December; 34(6):1403-8.

[32] Gackstetter, G.D., Hooper, T.I., DeBakey, S.F., Johnson, A., Nagaraj, B.E. and Heller, J.M. et al. Fatal motor vehicle crashes among veterans of the 1991 Gulf War and exposure to munitions demolitions at Khamisiyah: a nested case-control study. Am J Ind Med 2006 April; 49(4):261-70.

[33] Lincoln, A.E., Hooper, T.I., Kang, H.K., DeBakey, S.F., Cowan, D.N. and Gackstetter, G.D. Motor vehicle fatalities among Gulf War era veterans: characteristics, mechanisms, and circumstances. Traffic Inj Prev 2006 March; 7(1):31-7.

[34] Knapik, J.J., Marin, R.E., Grier, T.L. and Jones, B.H. A systematic review of post-deployment injury-related mortality among military personnel deployed to conflict zones. BMC Public Health 2009 July 13; 9:231.

[35] Kang, H.K., Bullman, T.A., Macfarlane, G.J. and Gray, G.C. Mortality among US and UK veterans of the Persian Gulf War: a review. Occup Environ Med 2002 December; 59(12):794-9.

[36] Armed Forces Health Surveillance Center. Termporal characteristics of motor vehicle-related fatalities, U.S. Armed Forces, 1998 – 2009. Medical Surveillance Monthly Report 2010 May; 17(5):2-6.

[37] Zwerling, C., Torner, J.C., Clarke, W.R., Voelker, M.D., Doebbeling, B.N. and Barrett, D.H. et al. Self-reported postwar injuries among Gulf War veterans. Public Health Rep 2000 July; 115(4):346-9.

[38] Gray, G.C., Coate, B.D., Anderson, C.M., Kang, H.K., Berg, S.W. and Wignall, F.S. et al. The postwar hospitalization experience of U.S. veterans of the Persian Gulf War. New England Journal of Medicine 1996 November 14; 335(20):1505-13.

[39] Gray, G.C., Smith, T.C., Kang, H.K. and Knoke, J.D. Are Gulf War veterans suffering war-related illnesses? Federal and civilian hospitalizations examined, June 1991 to December 1994. Am J Epidemiol 2000 January 1; 151(1):63-71.

[40] Bray, R.M., Pemberton, M.R. and Hourani, L.L. 2008 Department of Defense (US) Survey of Health Related Behaviors. Research Triangle Park, NC: RTI International; 2009 Aug. Report No.: RTI/ 10940-FR.

[41] Department of National Defence. 2008/2009 Health and Lifestyle Information Survey: Regular Forces Report. Ottawa, ON: Department of National Defence; 2010.

[42] Fear, N.T., Iversen, A.C., Chatterjee, A., Jones, M., Greenberg, N. and Hull, L. et al. Risky driving among regular armed forces personnel from the United kingdom. Am J Prev Med 2008 September; 35(3):230-6.

[43] Verrall, N.G. The role of risk in the health behaviours of military personnel in the UK Armed Forces: Final customer report. Porton Down, Wiltshire, UK: Defence Science and Technology Laboratory; 2009. Report No.: DSTL/CR33456.

[44] Siegel, P.Z., Brackbill, R.M., Frazier, E.L., Mariolis, P., Sanderson, L.M. and Waller, M.N. Behavioral risk factor surveillance, 1986-1990. MMWR CDC Surveill Summ 1991 December; 40(4):1-23.

[45] Powell, N.B. and Chau, J.K. Sleepy driving. Med Clin North Am 2010 May; 94(3):531-40.

[46] Radun, I., Radun, J.E., Summala, H. and Sallinen, M. Fatal road accidents among Finnish military conscripts: fatigue-impaired driving. Mil Med 2007 November; 172(11):1204-10.

[47] Decima Research, Inc. CF Health and Lifestyle Information Survey 2000: Regular Force Report. Ottawa, ON: Decima Research, Inc.; 2002 June.

[48] Bray, R.M., Hourani, L.L. and Rae Olmsted, K.L. 2005 Department of Defense (US) Survey of Health Related Behaviors. Research Triangle Park, NC: RTI International; 2006 Dec. Report No.: RTI/7841/106-FR.

[49] Niebuhr, D.W., Krampf, R.L., Mayo, J.A., Blandford, C.D., Levin, L.I. and Cowan, D.N. Risk factors for disability retirement among healthy adults joining the U.S. Army. Mil Med 2011 February; 176(2):170-5.

[50] Wilson, J., Jones, M., Fear, N.T., Hull, L., Hotopf, M. and Wessely, S. et al. Is previous psychological health associated with the likelihood of Iraq War deployment? An investigation of the "healthy warrior effect". Am J Epidemiol 2009 June 1; 169(11):1362-9.

[51] Toomey, R. Invited commentary: how healthy is the "healthy warrior"? Am J Epidemiol 2008 June 1; 167(11):1277-80.

[52] Lincoln, A.E., Hooper, T.I., Kang, H.K., DeBakey, S.F., Cowan, D.N. and Gackstetter, G.D. Motor vehicle fatalities among Gulf War era veterans: characteristics, mechanisms, and circumstances. Traffic Inj Prev 2006 March; 7(1):31-7.

[53] Jordan, B.K., Schlenger, W.E., Hough, R., Kulka, R.A., Weiss, D. and Fairbank, J.A. et al. Lifetime and current prevalence of specific psychiatric disorders among Vietnam veterans and controls. Arch Gen Psychiatry 1991 March; 48(3):207-15.

[54] Sewell, R.A., Poling, J. and Sofuoglu, M. The effect of cannabis compared with alcohol on driving. Am J Addict 2009 May; 18(3):185-93.

[55] Mann, R.E., Stoduto, G., Ialomiteanu, A., Asbridge, M., Smart, R.G. and Wickens, C.M. Self-reported collision risk associated with cannabis use and driving after cannabis use among Ontario adults. Traffic Inj Prev 2010 April; 11(2):115-22.

[56] Lew, H.L., Amick, M.M., Kraft, M., Stein, M.B. and Cifu, D.X. Potential driving issues in combat returnees. NeuroRehabilitation 2010 January; 26(3):271-8.

[57] Adler, A.B. and Castro, C.A. BATTLEMIND training system: mental health training across the deployment cycle. 2007. Unpublished paper presented at the 49th Annual International Military Testing Association Conference, Gold Coast, Queensland, Australia.

[58] Stern, E. and Rockwood, T. Post-deployment driving problems: survey of scope and timeline for post-deployment soldiers with and without traumatic brain injury. Paper presented at the Military Medical Research Forum, Kansas City, MO, USA, 31 August 2009.

[59] Kuhn, E., Drescher, K., Ruzek, J. and Rosen, C. Aggressive and unsafe driving in male veterans receiving residential treatment for PTSD. J Trauma Stress 2010 June; 23(3):399-402.

[60] Hoge, C.W., Castro, C.A., Messer, S.C., McGurk, D., Cotting, D.I. and Koffman, R.L. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. N Engl J Med 2004 July 1; 351(1):13-22.

[61] Clapp, J.D., Olsen, S.A., Noff-Burg, S., Hagewood, J.H., Hickling, E.J. and Hwang, V.S. et al. Factors contributing to anxious driving behavior: The role of stress history and accident severity. J Anxiety Disord 2011 May; 25(4):592-8.

[62] Okpala, N.C., Ward, N.J. and Bhullar, A. Seatbelt use among military personnel during operational deployment. Mil Med 2007 December; 172(12):1231-3.

[63] Barbone, F., McMahon, A.D., Davey, P.G., Morris, A.D., Reid, I.C. and McDevitt, D.G. et al. Association of road-traffic accidents with benzodiazepine use. Lancet 1998 October 24; 352(9137): 1331-6.

[64] Movig, K.L., Mathijssen, M.P., Nagel, P.H., van, E.T., de Gier, J.J. and Leufkens, H.G. et al. Psychoactive substance use and the risk of motor vehicle accidents. Accid Anal Prev 2004 July; 36(4):631-6.

[65] Rapoport, M.J., Lanctot, K.L., Streiner, D.L., Bedard, M., Vingilis, E. and Murray, B. et al. Benzodiazepine use and driving: a meta-analysis. J Clin Psychiatry 2009 May; 70(5):663-73.

[66] Hooper, T.I., DeBakey, S.F., Pearse, L., Pratt, S. and Hoffman, K.J. The use of electronic pharmacy data to investigate prescribed medications and fatal motor vehicle crashes in a military population, 2002-2006. Accid Anal Prev 2010 January; 42(1):261-8.

[67] Killgore, W.D., Cotting, D.I., Thomas, J.L., Cox, A.L., McGurk, D. and Vo, A.H. et al. Post-combat invincibility: violent combat experiences are associated with increased risk-taking propensity following deployment. J Psychiatr Res 2008 October; 42(13):1112-21.

[68] Smith, T.C., Ryan, M.A., Wingard, D.L., Slymen, D.J., Sallis, J.F. and Kritz-Silverstein, D. New onset and persistent symptoms of post-traumatic stress disorder self reported after deployment and combat exposures: prospective population based US military cohort study. BMJ 2008 February 16; 336(7640):366-71.

[69] Zamorski, M.A. Report on the findings of the enhanced post-deployment screening of those returning from Op ARCHER/Task Force Afghanistan as of 11 February 2011. Ottawa: Department of National Defence (Canada); 2011.

[70] Sareen, J., Cox, B.J., Afifi, T.O., Stein, M.B., Belik, S.L. and Meadows, G. et al. Combat and peacekeeping operations in relation to prevalence of mental disorders and perceived need for mental health care: findings from a large representative sample of military personnel. Arch Gen Psychiatry 2007 July; 64(7):843-52.

[71] Belik, S.L., Stein, M.B., Asmundson, G.J. and Sareen, J. Relation between traumatic events and suicide attempts in Canadian military personnel. Can J Psychiatry 2009 February; 54(2):93-104.

[72] Allebeck, P., Allgulander, C., Henningsohn, L. and Jakobsson, S.W. Causes of death in a cohort of 50,465 young men – validity of recorded suicide as underlying cause of death. Scand J Soc Med 1991 December; 19(4):242-7.

[73] Connolly, J.F., Cullen, A. and McTigue, O. Single road traffic deaths – accident or suicide? Crisis 1995; 16(2):85-9.

[74] Hernetkoski, K. and Keskinen, E. Self-destruction in Finnish motor traffic accidents in 1974-1992. Accid Anal Prev 1998 September; 30(5):697-704.

[75] Noyes, R., Jr. Motor vehicle accidents related to psychiatric impairment. Psychosomatics 1985 July; 26(7):569-6, 579.

[76] Ohberg, A., Penttila, A. and Lonnqvist, J. Driver suicides. Br J Psychiatry 1997 November; 171:468-72.:468-72.

[77] Peck, D.L. and Warner, K. Accident or suicide? Single-vehicle car accidents and the intent hypothesis. Adolescence 1995; 30(118):463-72.

[78] Pompili, M., Girardi, P., Tatarelli, G. and Tatarelli, R. Suicidal intent in single-car accident drivers: Review and new preliminary findings. Crisis 2006; 27(2):92-9.

[79] Schmidt, C.W., Jr., Shaffer, J.W., Zlotowitz, H.I. and Fisher, R.S. Suicide by vehicular crash. Am J Psychiatry 1977 February; 134(2):175-8.

[80] Wyatt, J.P., Squires, T., Collis, S. and Broadley, R. Road traffic suicides. J Forensic Leg Med 2009 May; 16(4):212-4.

[81] Seelig, A.D., Jacobson, I.G., Smith, B., Hooper, T.I., Boyko, E.J. and Gackstetter, G.D. et al. Sleep patterns before, during, and after deployment to Iraq and Afghanistan. Sleep 2010 December; 33(12):1615-22.

[82] Smolensky, M.H., Di, M.L., Ohayon, M.M. and Philip, P. Sleep disorders, medical conditions, and road accident risk. Accid Anal Prev 2011 March; 43(2):533-48.

[83] Davis, G. How did we do? Fiscal 2007 off-duty ground accident review. Knowledge: Official Safety Magazine of the U S Army 2008; 2:14-21.

[84] Gold, D.R., Rogacz, S., Bock, N., Tosteson, T.D., Baum, T.M. and Speizer, F.E. et al. Rotating shift work, sleep, and accidents related to sleepiness in hospital nurses. Am J Public Health 1992 July; 82(7):1011-4.

[85] Heaton, K., Browning, S. and Anderson, D. Identifying variables that predict falling asleep at the wheel among long-haul truck drivers. AAOHN J 2008 September; 56(9):379-85.

[86] Robb, G., Sultana, S., Ameratunga, S. and Jackson, R. A systematic review of epidemiological studies investigating risk factors for work-related road traffic crashes and injuries. Inj Prev 2008 February; 14(1):51-8.

[87] Connor, J., Whitlock, G., Norton, R. and Jackson, R. The role of driver sleepiness in car crashes: a systematic review of epidemiological studies. Accid Anal Prev 2001 January; 33(1):31-41.

[88] Wright, K.M., Adler, A.B., Bliese, P.D. and Eckford, R.D. Structured clinical interview guide for postdeployment psychological screening programs. Mil Med 2008 May; 173(5):411-21.

[89] Sayer, N.A., Noorbaloochi, S., Frazier, P., Carlson, K., Gravely, A. and Murdoch, M. Reintegration problems and treatment interests among Iraq and Afghanistan combat veterans receiving VA medical care. Psychiatr Serv 2010 June; 61(6):589-97.

[90] Chemtob, C.M., Hamada, R.S., Roitblat, H.L. and Muraoka, M.Y. Anger, impulsivity, and anger control in combat-related posttraumatic stress disorder. J Consult Clin Psychol 1994 August; 62(4):827-32.

[91] Dyer, K.F., Dorahy, M.J., Hamilton, G., Corry, M., Shannon, M. and MacSherry, A. et al. Anger, aggression, and self-harm in PTSD and complex PTSD. J Clin Psychol 2009 October; 65(10):1099-114.

[92] Jakupcak, M., Conybeare, D., Phelps, L., Hunt, S., Holmes, H.A. and Felker, B. et al. Anger, hostility, and aggression among Iraq and Afghanistan War veterans reporting PTSD and subthreshold PTSD. J Trauma Stress 2007 December; 20(6):945-54.

[93] Novaco, R.W. and Chemtob, C.M. Anger and combat-related posttraumatic stress disorder. Journal of Traumatic Stress 2002 April; 15(2):123-32.

[94] Dula, C.S. and Geller, E.S. Risky, aggressive, or emotional driving: addressing the need for consistent communication in research. J Safety Res 2003; 34(5):559-66.

[95] Deffenbacher, J.L., Lynch, R.S., Filetti, L.B., Dahlen, E.R. and Oetting, E.R. Anger, aggression, risky behavior, and crash-related outcomes in three groups of drivers. Behavior Research and Therapy 2003 March; 41(3):333-49.

[96] Friedl, K.E., Grate, S.J. and Proctor, S.P. Neuropsychological issues in military deployments: lessons observed in the DoD Gulf War Illnesses Research Program. Mil Med 2009 April; 174(4):335-46.

[97] Thomas, H.V., Stimpson, N.J., Weightman, A.L., Dunstan, F. and Lewis, G. Systematic review of multi-symptom conditions in Gulf War veterans. Psychol Med 2006 June; 36(6):735-47.

[98] Bullman, T.A., Mahan, C.M., Kang, H.K. and Page, W.F. Mortality in US Army Gulf War veterans exposed to 1991 Khamisiyah chemical munitions destruction. Am J Public Health 2005 August; 95(8):1382-8.

[99] Hoge, C.W., McGurk, D., Thomas, J.L., Cox, A.L., Engel, C.C. and Castro, C.A. Mild traumatic brain injury in U.S. Soldiers returning from Iraq. N Engl J Med 2008 January 31; 358(5):453-63.

[100] Zamorski, M.A. Preliminary report on the self-reported incidence of mild traumatic brain injury/ concussion in CF members deployed in support of the mission in Afghanistan. Ottawa: Department of National Defence (Canada); 2009.

[101] Terrio, H., Brenner, L.A., Ivins, B.J., Cho, J.M., Helmick, K. and Schwab, K. et al. Traumatic brain injury screening: preliminary findings in a US Army Brigade Combat Team. J Head Trauma Rehabil 2009 January; 24(1):14-23.

[102] Invisible Wounds of War: Psychological and Cognitive Injuries, Their Consequences, and Services to Assist Recovery. Santa Monica, CA: RAND Corporation; 2008.

[103] Cox, D.J., Davis, M., Singh, H., Barbour, B., Nidiffer, F.D. and Trudel, T. et al. Driving rehabilitation for military personnel recovering from traumatic brain injury using virtual reality driving simulation: a feasibility study. Mil Med 2010 June; 175(6):411-6.

[104] Wojcik, B.E., Stein, C.R., Bagg, K., Humphrey, R.J. and Orosco, J. Traumatic brain injury hospitalizations of U.S. army soldiers deployed to Afghanistan and Iraq. Am J Prev Med 2010 January; 38(1 Suppl):S108-S116.

[105] Belmont, A., Agar, N., Hugeron, C., Gallais, B. and Azouvi, P. Fatigue and traumatic brain injury. Ann Readapt Med Phys 2006 July; 49(6):283-4.

[106] Bushnik, T., Englander, J. and Wright, J. The experience of fatigue in the first 2 years after moderate-to-severe traumatic brain injury: a preliminary report. J Head Trauma Rehabil 2008 January; 23(1):17-24.

[107] Baumann, C.R., Werth, E., Stocker, R., Ludwig, S. and Bassetti, C.L. Sleep-wake disturbances 6 months after traumatic brain injury: a prospective study. Brain 2007 July; 130(Pt 7):1873-83.

[108] Lew, H.L., Pogoda, T.K., Hsu, P.T., Cohen, S., Amick, M.M. and Baker, E. et al. Impact of the “polytrauma clinical triad” on sleep disturbance in a department of veterans affairs outpatient rehabilitation setting. Am J Phys Med Rehabil 2010 June; 89(6):437-45.

[109] Busch, C.R. and Alpern, H.P. Depression after mild traumatic brain injury: a review of current research. Neuropsychol Rev 1998 June; 8(2):95-108.

[110] Belanger, H.G. and Vanderploeg, R.D. The neuropsychological impact of sports-related concussion: a meta-analysis. J Int Neuropsychol Soc 2005 July; 11(4):345-57.

[111] Carroll, L.J., Cassidy, J.D., Peloso, P.M., Borg, J., von, H.H. and Holm, L. et al. Prognosis for mild traumatic brain injury: results of the WHO Collaborating Centre Task Force on Mild Traumatic Brain Injury. J Rehabil Med 2004 February; (43 Suppl):84-105.

[112] Miller, L.J. and Mittenberg, W. Brief cognitive behavioral interventions in mild traumatic brain injury. Appl Neuropsychol 1998; 5(4):172-83.

[113] Stulemeijer, M., Vos, P.E., Bleijenberg, G. and van der Werf, S.P. Cognitive complaints after mild traumatic brain injury: things are not always what they seem. Journal of Psychosomatic Research 2007 December; 63(6):637-45.

[114] Stulemeijer, M., Andriessen, T.M., Brauer, J.M., Vos, P.E. and van der Werf, W.S. Cognitive performance after mild traumatic brain injury: the impact of poor effort on test results and its relation to distress, personality and litigation. Brain Inj 2007 March; 21(3):309-18.

[115] Stulemeijer, M., van der Werf, W.S., Borm, G.F. and Vos, P.E. Early prediction of favourable recovery 6 months after mild traumatic brain injury. J Neurol Neurosurg Psychiatry 2008 August; 79(8): 936-42.

[116] Pietrzak, R.H., Johnson, D.C., Goldstein, M.B., Malley, J.C. and Southwick, S.M. Posttraumatic stress disorder mediates the relationship between mild traumatic brain injury and health and psychosocial functioning in veterans of Operations Enduring Freedom and Iraqi Freedom. J Nerv Ment Dis 2009 October; 197(10):748-53.

[117] Polusny, M.A., Kehle, S.M., Nelson, N.W., Erbes, C.R., Arbisi, P.A. and Thuras, P. Longitudinal effects of mild traumatic brain injury and posttraumatic stress disorder comorbidity on postdeployment outcomes in national guard soldiers deployed to Iraq. Arch Gen Psychiatry 2011 January; 68(1):79-89.

[118] Marx, B.P., Brailey, K., Proctor, S.P., Macdonald, H.Z., Graefe, A.C. and Amoroso, P. et al. Association of time since deployment, combat intensity, and posttraumatic stress symptoms with neuropsychological outcomes following Iraq war deployment. Arch Gen Psychiatry 2009 September; 66(9):996-1004.

[119] Schneiderman, A.I., Braver, E.R. and Kang, H.K. Understanding sequelae of injury mechanisms and mild traumatic brain injury incurred during the conflicts in Iraq and Afghanistan: persistent postconcussive symptoms and posttraumatic stress disorder. Am J Epidemiol 2008 June 15; 167(12):1446-52.

[120] Cooper, D.B., Kennedy, J.E., Cullen, M.A., Critchfield, E., Amador, R.R. and Bowles, A.O. Association between combat stress and post-concussive symptom reporting in OEF/OIF service members with mild traumatic brain injuries. Brain Inj 2011; 25(1):1-7.

[121] Spencer, R.J., Drag, L.L., Walker, S.J. and Bieliauskas, L.A. Self-reported cognitive symptoms following mild traumatic brain injury are poorly associated with neuropsychological performance in OIF/OEF veterans. NeuroRehabilitation 2010; 47(6):521-30.

[122] Vasterling, J.J., Verfaellie, M. and Sullivan, K.D. Mild traumatic brain injury and posttraumatic stress disorder in returning veterans: perspectives from cognitive neuroscience. Clin Psychol Rev 2009 December; 29(8):674-84.

[123] Ryb, G.E., Dischinger, P.C., Kufera, J.A. and Read, K.M. Risk perception and impulsivity: association with risky behaviors and substance abuse disorders. Accid Anal Prev 2006 May; 38(3):567-73.

[124] Jonah, B.A. Sensation seeking and risky driving: a review and synthesis of the literature. Accid Anal Prev 1997 September; 29(5):651-65.

[125] Hatfield, J. and Fernandes, R. The role of risk-propensity in the risky driving of younger drivers. Accid Anal Prev 2009 January; 41(1):25-35.

[126] MacPherson, L., Magidson, J.F., Reynolds, E.K., Kahler, C.W. and Lejuez, C.W. Changes in sensation seeking and risk-taking propensity predict increases in alcohol use among early adolescents. Alcohol Clin Exp Res 2010 August; 34(8):1400-8.

[127] Caspi, A., Roberts, B.W. and Shiner, R.L. Personality development: stability and change. Annu Rev Psychol 2005; 56:453-84.:453-84.

[128] Hipps, T. Warrior Adventure Quest: high-adrenaline activities help soldiers transition. CNN iReport Web Site 2011 June 3; Available from: URL: http://ireport.cnn.com/docs/DOC-617466.

[129] Jonah, B.A. Sensation seeking and risky driving: a review and synthesis of the literature. Accid Anal Prev 1997 September; 29(5):651-65.

[130] Llewellyn, D.J. The psychology of risk taking: toward the integration of psychometric and neuropsychological paradigms. Am J Psychol 2008; 121(3):363-76.

[131] Zermatten, A., Van der Linden, L.M., d'Acremont, M., Jermann, F. and Bechara, A. Impulsivity and decision making. J Nerv Ment Dis 2005 October; 193(10):647-50.

[132] Hilakivi, I., Veilahti, J., Asplund, P., Sinivuo, J., Laitinen, L. and Koskenvuo, K. A sixteen-factor personality test for predicting automobile driving accidents of young drivers. Accid Anal Prev 1989 October; 21(5):413-8.

[133] Vasterling, J.J., Proctor, S.P., Amoroso, P., Kane, R., Heeren, T. and White, R.F. Neuropsychological outcomes of army personnel following deployment to the Iraq war. JAMA 2006 August 2; 296(5):519-29.

[134] Billieux, J., Gay, P., Rochat, L. and Van der Linden, L.M. The role of urgency and its underlying psychological mechanisms in problematic behaviours. Behav Res Ther 2010 November; 48(11):1085-96.

[135] Rhodes, N. and Pivik, K. Age and gender differences in risky driving: the roles of positive affect and risk perception. Accid Anal Prev 2011 May; 43(3):923-31.

[136] Adler, A.B., Zamorski, M.A. and Britt, T.W. The psychology of transition: adapting to home after deployment. In: Adler AB, Bliese PD, Castro CA, editors. Deployment Psychology: Evidence-based Strategies to Promote Mental Health in the Military. Washington, DC: American Psychological Association; 2010. pp. 153-74.

[137] Lyvers, M. and Tobias-Webb, J. Effects of acute alcohol consumption on executive cognitive functioning in naturalistic settings. Addict Behav 2010 November; 35(11):1021-8.

[138] Quinn, P.D., Stappenbeck, C.A. and Fromme, K. Collegiate heavy drinking prospectively predicts change in sensation seeking and impulsivity. J Abnorm Psychol 2011 August; 120(3):543-56.

[139] Killgore, W.D., Kamimori, G.H. and Balkin, T.J. Caffeine protects against increased risk-taking propensity during severe sleep deprivation. J Sleep Res 2011 September; 20(3):395-403.

[140] Fernandes, R., Job, R.F. and Hatfield, J. A challenge to the assumed generalizability of prediction and countermeasure for risky driving: different factors predict different risky driving behaviors. J Safety Res 2007; 38(1):59-70.

Chapter 6 – DISCUSSION

6.1 OVERVIEW

This discussion section will serve to:

- Summarize the key findings of RTG-164's work;
- Explore hypotheses for the effect that deployment may have on health risk behaviours;
- Identify priorities for future research; and
- Identify priorities for mitigation of deployment-related health risk behaviours.

6.2 SUMMARY OF KEY FINDINGS

RTG-164 began by developing a large list of potential health risk behaviours that could be affected by deployment. This list included the following health risk behaviours:

- Tobacco use;
- Risky alcohol use;
- Risky driving behaviours;
- Sleep/rest behaviours;
- Risky behaviours other than those related to motor vehicles (e.g., falls);
- Stimulant use;
- Hygiene (e.g., hand-washing);
- Exercise;
- Malaria prevention/arthropod protection behaviours;
- Immunization uptake;
- Risky sexual behaviour;
- Risky eating habits; and
- Use of illicit drugs.

The Task Group did not include suicide or other forms of intentional self-harm as a health risk behaviour, given the ample attention this issue from another NATO RTG.

To make its work manageable, the Task Group proposed a set of ten criteria to be used in order to identify the behaviours that should be of greatest interest for military organizations. These included:

- The impact of the behaviour on operational effectiveness;
- The strength of the evidence of a relationship to deployment;
- The relevance of the psychology of risk to the behaviour;
- The public health impact of the behaviour;
- The impact of the behaviour on individual well-being;
- The impact of the behaviour on non-operational effectiveness in military organizations;
- The ability to influence the behaviour through individual-level interventions;

- The ability to influence the behaviour at the environmental level;
- The out-of-pocket cost of the behaviour for the individual; and
- The effect of the behaviour on health care costs.

The first three of these criteria were judged by the RTG to be most important for its work. Of the behaviours listed above, the RTG judged that risky driving, tobacco use, and risky drinking were the behaviours of greatest interest to the RTG. Sleep and rest behaviours were judged to have a strong effect on operational effectiveness, strong evidence of an association with deployment, and a small relevance to the psychology of risk. However, there has been extensive work on the important topic of sleep and fatigue management in NATO and elsewhere, so this was not judged to be a high priority for RTG-164.

RTG members reviewed the scientific literature and did some original research to explore the relationship between deployment and three key behaviours (tobacco use, risky driving, and risky drinking). RTG-164 found strong and consistent evidence of an association between at least some deployments and these behaviours. A number of well-done cross-sectional studies and a few longitudinal studies suggest that the association between deployment and both tobacco use and risky drinking is causal in nature. Numerous cross-sectional and cohort studies supported a relationship between deployment and risky driving behaviour. In addition, the RTG found compelling the association between at least some deployments (specifically the Vietnam War and the 1990 – 1991 Gulf War) and later death from external causes of death including motor vehicle accidents. The limited longitudinal data showing that deployment was associated with a *decline* in self-reported risky driving behaviour from pre- to post-deployment is hard to reconcile against this finding. One possible explanation for this apparent disparity is residual confounding in the cross-sectional studies (i.e., that deployed cohorts had different risk taking propensity than non-deployed cohorts).

6.3 MECHANISMS: HOW DOES DEPLOYMENT INFLUENCE HEALTH RISK BEHAVIOURS?

We found evidence that deployment influences at least three health risk behaviours: tobacco use, risky driving, and risky drinking. This section explores possible common mechanisms for this effect.

While medical professionals treat health risk behaviours as a group (with the common element being that they are behaviours with a negative impact on health), these are diverse behaviours that are driven by (and then sustained by) very diverse factors: What makes a person start smoking as an adolescent is very different from what makes it difficult for a life-long smoker to quit. Different patterns of risk behaviours (e.g., heavy daily drinking vs. occasional binge drinking) have different drivers and different consequences. Some health risk behaviours actually consist of a series of complex behaviours, each of which has its own substrate and consequences. This is most apparent in driving behaviours: Getting behind the wheel when intoxicated is different from failure to use seatbelts, which in turn are different from thrill-seeking through road racing and driving while sleep-deprived.

The experience of deployment is equally complex and variable: Many deployed personnel do not experience combat, and even those who do experience it in different ways. Deployment can consist of both highly positive experiences (the sense of reward from having served one's country) and highly negative experiences (losing valued friends and colleagues in combat).

Despite the variability and complexity of the deployment experience and of health risk behaviours, the ability of the former to have a consistent effect on the latter demands an explanation. The following sub-section lays out some hypotheses entertained by the RTG that could explain the link between deployment and at least these three health risk behaviours.

6.3.1 Artifact

While many of the studies on the association between deployment and health risk behaviours are of high quality, all are observational in that they compare the health behaviours in cohorts who deployed or happened not to deploy. Randomizing large groups of personnel to deploy or not deploy for research purposes would eliminate many possible sources of bias, but this is not a realistic option. All observational studies have controlled for the confounding effects of measured covariates (e.g., age, sex), but residual confounding is always a possibility. In particular, it is difficult to exclude the plausible possibility that those who deploy are intrinsically more risk-prone than those who don't. Longitudinal studies of risk behaviours of deployed and non-deployed cohorts can help, but there is still some potential for bias.

6.3.2 Distress and Mental Disorders

Psychological distress and mental disorders are both common consequences of demanding deployments, particularly those associated with traumatic stressors such as combat. The association of combat exposure and deployment-related health risk behaviours would be expected if distress and mental disorders (known to be combat-related) were key mediators.

Mediation by mental disorders is most convincing for alcohol use disorders in combat veterans; some studies have shown that all or nearly all of the increased risk of alcohol used disorders is mediated by other co-morbid mental disorders, notably PTSD [1]. Alcohol use disorders represent only a sub-set of risky drinking behaviours, and RTG-164 could not locate any studies looking at the possible mediation of risky drinking in general. However, there is strong evidence that those with PTSD [2], other anxiety disorders [3], and mood disorders [4] do "self-medicate" with alcohol to control their symptoms. The consensus in the research community seems to be that mental disorders leading to alcohol use is a stronger pathway than alcohol use leading to other mental disorders. Thus, the RTG judged it very likely that a significant part of effect of deployment on risky drinking is mediated by distress and mental disorders.

Tobacco use has a complicated relationship with mental disorders. Longitudinal studies show that it is both a contributor to and a consequence of mood and anxiety disorders. That is, smokers have an increased risk of later developing these disorders [5], and those with mental disorders have an increased risk of later tobacco use [6];[7]. Different studies have yielded different results when it comes to which causal pathway is stronger (i.e., smoking leading to mental disorders or mental disorders leading to smoking). This may relate to differences in the study populations, the time period of observation, or other methodological differences. Nevertheless, RTG-164 concluded that it was plausible that distress and mental disorders contribute at least in part to the increased risk of smoking seen in those who have deployed; the magnitude of this effect is likely smaller than the corresponding association with risky drinking.

The link between mental disorders and risky driving behaviour is less well understood, in largest measure because it has not been as well researched. In addition, as described in an earlier chapter, risky driving is a complex set of behaviours. The mechanisms by which mental disorders could contribute to risky driving behaviour are explored in depth in that same chapter:

- Mental disorders and distress can lead to alcohol or drug use, which in turn could impair driving;
- Failure to adapt combat driving behaviour to the home environment, which is at least in part driven by post-deployment anxieties;
- Anxiety and depression may have direct effects on driving performance and indirect effects through the used of potentially impairing medications used in their treatment;
- Sleep disturbance, which is a cardinal symptom of mood and anxiety disorders; and
- Anger and aggressivity, which again is an important symptom of mood and anxiety disorders.

As noted earlier in the chapter on risking driving behaviours, it is plausible that distress and mental disorders may exert part of their effect on health risk behaviours through changes in risk psychology variables.

RTG-164 therefore thought that it is likely that distress and mental disorders mediate (directly or indirectly) at least some of the deployment-related increase in health risk behaviours. For nearly all studies (both cross-sectional and longitudinal), it is impossible to exclude the possibility that the associations between mental distress and health risk behaviours are seen because they share a common substrate (genetic or environmental) as opposed to one causing the other. Studies of twins [8];[9] who are discordant for combat experience have confirmed that much (but not all) of the association between post-combat mental disorders and tobacco and alcohol use is due to shared genetic and environmental factors as opposed to a primary causal effect of mental disorders.

Thus, for all three health risk behaviours considered in this report, the Task Group thought that distress and mental disorders were significant mediators, although the evidence is weakest for tobacco use. However, much of the apparent link between disorders and health risk behaviours is due to their sharing some of the same genetic and environmental substrates.

6.3.3 Risk-Related Issues

Some of the pertinent issues related to risk, health behaviours and deployment will be briefly discussed. This is not only pertinent regarding the risky health behaviours of military personnel, but also includes the broader aspects of the psychology of risk and the variation and nature of military deployments, both operational and otherwise (e.g., humanitarian relief, peacekeeping, counterinsurgency).

6.3.3.1 Measuring Military Risk-Taking

One of the challenges facing the military's increasing interest in 'risk' is whether military personnel adequately reflect civilian populations or whether the military is a bespoke population that requires special attention. This is an important issue as it helps to decide whether measures of military risk can be utilised from the non-military academic literature, as in the case of the sensations seeking personality [10] or whether there is a genuine research gap that requires the military and Defence Scientists to develop bespoke tools for measuring military risk, as in the case of the Evaluation of Risk (EVAR) scale [11];[12] or the Measure of Operational Risk-taking scale [13].

A recent systematic review [14] of sensation seeking studies that have used military samples as part of their research suggests that the military are not as high or dominant in sensation seeking as might be assumed; for example, the military appeared to score higher than civilian samples on the sensation seeking sub-scales of thrill and adventure seeking, and on experience seeking, but the civilian samples appeared to score higher on the sub-scales of dis-inhibition and boredom susceptibility. However, in a recent UK study [15];[16] the military (Army) sample was statistically higher in "impulsive sensation seeking" [17] when compared to a comparable U.S. civilian sample [18], matched for age and gender . The systematic reviews [14];[16] also highlighted a range of methodological issues and the low number of such military studies, so that at this stage it would not be accurate to conclude that the military are higher in risk-taking propensity and risk-taking behaviour than comparable civilian populations.

6.3.3.2 Risk, Personality, and Health Behaviour

There are always anecdotes and myths that surround deployment-related behaviour. For example, that smoking always increases on deployments, that alcohol intake increases post-deployment, along with risky driving behaviour. The research reviewed and included within this report suggests mixed findings that both support and refute some of the assumptions regarding deployment-related health behaviour. To paraphrase Sir Isaac Newton, for every anecdote there is an equal and opposite anecdote.

Contrary to popular opinion, there are fewer studies than are assumed in the domain of military risk-taking; and this is especially the case for deployment-related and health-related risk studies. There are relatively few prospective, repeated measures studies across the deployment cycle and this highlights the need for such studies to help inform and educate those interested in the military health domain.

A study of military health behaviours on an operational deployment [16] found that although risk-taking personality was a significant predictor of current and future health behaviours, it only accounted for a maximum of 7% of the variance in multiple regression models. In fact, past behaviour and similar behaviour were found to be the strongest predictors, accounting for up to 44%. All of this suggests that the risk-taking personality tends to influence the individual's propensity to approach or withdraw from a specific risk behaviour, but the repeated reinforcement of that behaviour has a stronger influence (and predictive value) rather than personality *per se*.

The associations between risk and health behaviours in the civilian domain has been significantly researched and established; however, there is less evidence within the domain of military deployments. Therefore, there still appears to be a need to study the risk mechanisms that underpin military health behaviours on deployments, as well as to develop military models of risk and the associations and causal pathways that influence military behaviour.

Conducting this research will help to inform the assumption that the military are all risk-takers and/or "adrenaline junkies". The truth is that not enough research has been conducted (in terms of both *amount* and *breadth* of research) to provide the necessary evidence-base. To this effect, there is therefore a need for more military risk-taking studies, which need to address the methodological issues highlighted in the systematic review, as well as the methodological issues highlighted in this report previously (see the chapter on alcohol consumption).

6.3.4 Role of Deployment Experiences

Anecdotal evidence indicates that some Soldiers engage in more high-risk behaviors post-deployment (as discussed in [19]). While deployed, many soldiers are under conditions of high physical, psychological, and emotional stress which is linked to mental health issues [20]). Killgore et al. [19] argued that the effects of prolonged exposure to emotional stressors may impact brain regions (specifically the limbic system) in such a way that soldiers may have difficulty adjusting to a non-wartime environment upon returning from a deployment. Some evidence has shown that soldiers with Post-Traumatic Stress Disorder (PTSD) have diminished activity in the limbic system and prefrontal cortex suggesting low basal arousal levels [21]. It should be noted that increased risk propensity and actual risk behaviours are not limited to soldiers who are suffering from PTSD or other traumas. Given the research currently available, the extent to which deployment and combat experiences (particularly the frequency and intensity of those experiences) impact a soldier's perception of risk and risk propensity post-deployment is not yet known.

6.4 PRIORITIES FOR FUTURE RESEARCH

As previously discussed, research on health behaviours in military forces and the behaviour changes that may occur during the deployment cycle is underway. However, there is much progress to be made before an understanding of the relationship between combat deployment and health risk behaviours is achieved and, subsequently, appropriate intervention and prevention techniques are developed and implemented. The RTG identified eight priorities for research to progress in this area of study:

- To document the pattern of behaviour across the deployment cycle and also collect data on potential correlates including but not limited to cognitive abilities, stable and dynamic personality factors, demographics, symptoms of distress and mental disorders, and combat exposure. At present, few studies are working to accomplish this first goal using longitudinal design.

- To develop and validate a comprehensive model of how deployment influences health behaviours.
- To identify which external factors influence health risk behaviour (e.g., combat experience, deployment characteristics, social structure). Existing hypotheses postulate that combat experience and perceived threat may influence one's ability to accurately appraise risk in the environment. It is also suggested that intense combat exposure may be related to increased violent behaviours post-deployment.
- To identify who is at risk as defined by internal factors including but not limited to stable and dynamic personality traits, demographics, and military occupation/trade. It would also be advantageous to explore potential differences between Army, Navy, and Air Force services.
- To address the mechanism driving health risk behaviours and changes in risk propensity. Specifically, to address the meditation by mental health problems and other potential underpinning "proximate causes".
- To explore the role of schedule (rest and relaxation) and temporal aspects of post-deployment health risk behaviour. For instance, to understand when, if ever, increased risk behaviours begin to taper off and risk propensity begins to decrease or return to baseline. This information would be valuable for determination of the optimal time point for effective prevention trainings and interventions. Likewise, it would beneficial to understanding the pattern of behaviour change over time post-deployment.
- To explore cultural differences in health risk behaviors and behavior change across the deployment cycle such that interventions and training may be structured to best fit the needs of each culture and Nation.
- To explore a larger spectrum of health risk behaviors to include sexual health.
- Finally, to develop interventions to attenuate health risk behaviours and evaluate the effectiveness of these techniques. To do so, however, an understanding of the optimal time stamp for the intervention and mechanisms driving the behaviour (e.g., mental health, social/behavioural factors, deployment sanctions) must be adequately achieved. Likewise, considerations for accessibility, affordability, utility, and efficiency must be made.
- This entire research domain would benefit from more mixed-method research designs that utilised both quantitative and qualitative data. Such methods help to provide not only the numbers and statistical analysis, but also the contextual factors that underpin the perceptions and behaviours of military personnel; thus it is not imperative to measure the '*what*' but also understand the '*why*'.

In summary, the use of longitudinal, repeated measures studies that capture the full range of potential covariates and mechanisms and adopt a mixed method design would help to unpack the complexity of the mechanisms that influence risk perceptions, risk-taking and health behaviours across military deployments.

6.5 PREVENTION AND CONTROL PRIORITIES

While the additional research on the effect of deployment on health risk behaviours described above is clearly essential, military organizations will want to know what they can do right now to help mitigate this effect. The Task Group's five recommendations are as follows.

6.5.1 Priority Behaviours to Target

First and foremost, the three behaviours targeted by the Task Group (tobacco use, risky driving, and risky drinking) should be the top priorities for prevention and control efforts. They have powerful effects on health and well-being of personnel and hence have powerful effects on their functioning in the workplace.

There is strong evidence of a causal link with deployments, so military organizations have a special obligation to what they can to mitigate this effect. Moreover, all have countermeasures of proven efficacy to apply.

6.5.2 Address Risk Behaviours Primarily as Public Health Problems, Not Deployment Health Problems

Second, military organizations should continue to tackle these health risk behaviours as *public health problems* rather than *deployment health problems*. This is because they are prevalent and impactful in the non-deployed population as well, and it seems likely that the same types of individual-level and environmental interventions will be effective in both populations. As noted above, the associations with deployment are modest at best, and are most pronounced in those exposed to significant combat. Special targeting of this deployed population for such interventions around the time of deployment makes sense provided that similar attention is paid to the larger non-deployed population. It is possible that there will one day be specific interventions that work particularly well in the deployed population, but at present RTG-164 could not identify any with strong evaluation data behind them.

6.5.3 Mitigate Distress and Mental Disorders

Third, continued attention is needed to the mitigation of distress and mental disorders. As noted above, there is evidence that these at least partially mediate the linkage between deployment and health risk behaviours. Data is particularly strong for risky drinking. Mitigation efforts of course include primary prevention strategies such as resilience training, and there has been enormous attention to this area of late [22]-[24]. However, no prevention effort will be 100% effective. For this reason, military organizations need to do what they can to reverse the sad truth that most individuals with mental disorders are not in care, many reach care only many years after disorder onset, and many receive less than ideal care. Will efforts to mitigate mental disorders pay dividends when it comes to deployment-related risk behaviours? Time will tell, but efforts in this area will clearly lead to other benefits to service members and to military organizations.

Unfortunately, three factors will conspire to erode the impact of mitigation of distress and mental disorders on deployment-related health risk behaviours:

- As alluded to in the previous chapter, health risk behaviours can persist even after the factors that triggered them have abated;
- The link between mental disorders and health risk behaviours is driven in part by shared substrates as opposed to a cause-effect relationship; and
- Many factors other than distress and mental disorders lead to onset and persistence of health risk behaviours.

For these reasons, mitigation of distress and mental disorders is expected to have a limited (but still valuable) effect on health risk behaviours, whether deployment-related or not. In other words, mitigation of mental disorders cannot be the cornerstone of efforts to mitigate deployment-related health risk behaviours: These behaviours need to be targeted specifically with effective interventions. The main benefits of mitigation of mental disorders will lie elsewhere.

6.5.4 Use Sound Principles for Incorporation of Risk-Related Messages

Fourth, until it is clearer what precise role that changes in risk perception play in deployment-related health risk behaviours, the general principles surrounding the effective incorporation of risk-related messages in prevention and control efforts should be followed.

6.5.5 Leverage Environmental Interventions

Finally, environmental interventions are powerful tools to influence health behaviour. In tackling health risk behaviours, military organizations should leverage the have control that they have over a much broader range of environmental factors than the typical employer.

6.6 REFERENCES

[1] Scherrer, J.F., Xian, H., Lyons, M.J., Goldberg, J., Eisen, S.A. and True, W.R. et al. Posttraumatic stress disorder; combat exposure; and nicotine dependence, alcohol dependence, and major depression in male twins. Compr Psychiatry 2008 May; 49(3):297-304.

[2] Leeies, M., Pagura, J., Sareen, J. and Bolton, J.M. The use of alcohol and drugs to self-medicate symptoms of posttraumatic stress disorder. Depress Anxiety 2010 August; 27(8):731-6.

[3] Bolton, J., Cox, B., Clara, I. and Sareen, J. Use of alcohol and drugs to self-medicate anxiety disorders in a nationally representative sample. J Nerv Ment Dis 2006 November; 194(11):818-25.

[4] Bolton, J.M., Robinson, J. and Sareen, J. Self-medication of mood disorders with alcohol and drugs in the National Epidemiologic Survey on Alcohol and Related Conditions. J Affect Disord 2009 June; 115(3):367-75.

[5] Flensborg-Madsen, T., von Scholten, M.B., Flachs, E.M., Mortensen, E.L., Prescott, E. and Tolstrup, J.S. Tobacco smoking as a risk factor for depression. A 26-year population-based follow-up study. J Psychiatr Res 2011 February; 45(2):143-9.

[6] Griesler, P.C., Hu, M.C., Schaffran, C. and Kandel, D.B. Comorbidity of psychiatric disorders and nicotine dependence among adolescents: findings from a prospective, longitudinal study. J Am Acad Child Adolesc Psychiatry 2008 November; 47(11):1340-50.

[7] Breslau, N., Peterson, E.L., Schultz, L.R., Chilcoat, H.D. and Andreski, P. Major depression and stages of smoking. A longitudinal investigation. Arch Gen Psychiatry 1998 February; 55(2):161-6.

[8] Xian, H., Scherrer, J.F., Grant, J.D., Eisen, S.A., True, W.R. and Jacob, T. et al. Genetic and environmental contributions to nicotine, alcohol and cannabis dependence in male twins. Addiction 2008 August; 103(8):1391-8.

[9] Xian, H., Chantarujikapong, S.I., Scherrer, J.F., Eisen, S.A., Lyons, M.J. and Goldberg, J. et al. Genetic and environmental influences on posttraumatic stress disorder, alcohol and drug dependence in twin pairs. Drug Alcohol Depend 2000 December 22; 61(1):95-102.

[10] Zuckerman, M. Behavioural Expressions and Biosocial Bases of Sensation Seeking. Cambridge (UK): Cambridge University Press; 1994.

[11] Sicard, B., Jouve, E. and Blin, O. Risk propensity assessment in military special operations. Mil Med 2001 October; 166(10):871-4.

[12] Killgore, W.D., Vo, A.H., Castro, C.A. and Hoge, C.W. Assessing risk propensity in American soldiers: preliminary reliability and validity of the Evaluation of Risks (EVAR) scale – English version. Mil Med 2006 March; 171(3):233-9.

[13] Momen, N., Taylor, M.K. and Pietrobon, R. Initial validation of the Military Operational Risk Taking Scale (MORTS). Military Psychology 2010; 22:128-42.

[14] Verrall, N.G. A systematic review of sensation seeking research using military samples. 2009. As cited in: Verrall NG. The role of risk in the health behaviours of military personnel in the UK Armed Forces PhD Thesis. University of Surrey; 2011.

[15] Verrall, N.G. The role of risk in the health behaviours of military personnel in the UK Armed Forces: Final customer report. Porton Down, Wiltshire, UK: Defence Science and Technology Laboratory; 2009. Report No.: DSTL/CR33456.

[16] Verrall, N.G. The role of risk in the health behaviours of military personnel in the UK Armed Forces University of Surrey; 2011.

[17] McDaniel, S.R. and Mahan, J.E. An examination of the ImpSS scale as a valid and reliable alternative to the SSS-V in optimum stimulation level research. Personality and Individual Differences 2008; 44:1528-38.

[18] McDaniel, S.R. and Zuckerman, M. The relationship of impulsive sensation seeking and gender to interest and participation in gambling activities. Personality and Individual Differences 2003; 35:1385-400.

[19] Killgore, W.D., Cotting, D.I., Thomas, J.L., Cox, A.L., McGurk, D. and Vo, A.H. et al. Post-combat invincibility: Violent combat experiences are associated with increased risk-taking propensity following deployment. J Psychiatr Res 2008 February.

[20] Hoge, C.W., Castro, C.A., Messer, S.C., McGurk, D., Cotting, D.I. and Koffman, R.L. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. N Engl J Med 2004 July 1; 351(1):13-22.

[21] Molina, M.E., Isoardi, R., Prado, M.N. and Bentolila, S. Basal cerebral glucose distribution in long-term post-traumatic stress disorder. World J Biol Psychiatry 2010 March; 11(2 Pt 2):493-501.

[22] Casey, G.W., Jr. Comprehensive soldier fitness: A vision for psychological resilience in the U.S. Army. Am Psychol 2011 January; 66(1):1-3.

[23] Cornum, R., Matthews, M.D. and Seligman, M.E. Comprehensive soldier fitness: Building resilience in a challenging institutional context. Am Psychol 2011 January; 66(1):4-9.

[24] Seligman, M.E. and Fowler, R.D. Comprehensive Soldier Fitness and the future of psychology. Am Psychol 2011 January; 66(1):82-6.

REPORT DOCUMENTATION PAGE

1. Recipient's Reference	2. Originator's References	3. Further Reference	4. Security Classification of Document
	RTO-TR-HFM-164 AC/323(HFM-164)TP/429	ISBN 978-92-837-0161-3	UNCLASSIFIED/ UNLIMITED

5. Originator

Research and Technology Organisation
North Atlantic Treaty Organisation
BP 25, F-92201 Neuilly-sur-Seine Cedex, France

6. Title

Psychological Aspects of Deployment and Health Behaviours

7. Presented at/Sponsored by

This Report documents the findings of Task Group 164, which investigated the role and impact of psychological factors, including the psychology of risk, upon the risky health behaviours of military personnel on deployments. This report also discusses the underlying mechanisms for such behaviours, as well as the need for health interventions, training and education, and future research.

8. Author(s)/Editor(s)	9. Date
Multiple	May 2012
10. Author's/Editor's Address	**11. Pages**
Multiple	86

12. Distribution Statement

There are no restrictions on the distribution of this document. Information about the availability of this and other RTO unclassified publications is given on the back cover.

13. Keywords/Descriptors

Alcohol use
Deployment
Driving, road traffic accidents
Health risk behaviours
Mental disorders
Military
Psychology
Risk perception
Tobacco use

14. Abstract

Background: Health risk behaviours are important threats to operational effectiveness and force sustainability in military organizations, and there is evidence that at least some deployments are associated with an increase of at least some of these behaviours. **Method**: A preliminary literature review and some original research identified three health risk behaviours of greatest relevance to military organizations based on their health impact and evidence of association with deployment: Tobacco use, high-risk drinking, and risky driving. **Results**: In-depth literature review and some original research confirmed the causal association of at least some deployments on these behaviours. Possible common mechanisms for this association include distress and mental disorders and changes in risk perception/risk tolerance. **Conclusions**: Research on deployment and health risk behaviours should focus on tobacco use, risky drinking, and risky driving as top priorities. Military organizations should tackle these health risk behaviours as public health problems affecting the military as a whole as opposed to as deployment health problems. Mitigation of distress and mental disorders may help attenuate health risk behaviours, but the expected magnitude of this effect is small. For this reason, these health risk behaviours should be specifically targeted with methods of proven efficacy, and the military should leverage the unusual degree of control it has over the environment in its mitigation efforts.

NORTH ATLANTIC TREATY ORGANISATION

RESEARCH AND TECHNOLOGY ORGANISATION

BP 25
F-92201 NEUILLY-SUR-SEINE CEDEX • FRANCE
Télécopie 0(1)55.61.22.99 • E-mail mailbox@rta.nato.int

DIFFUSION DES PUBLICATIONS

RTO NON CLASSIFIEES

Les publications de l'AGARD et de la RTO peuvent parfois être obtenues auprès des centres nationaux de distribution indiqués ci-dessous. Si vous souhaitez recevoir toutes les publications de la RTO, ou simplement celles qui concernent certains Panels, vous pouvez demander d'être inclus soit à titre personnel, soit au nom de votre organisation, sur la liste d'envoi.

Les publications de la RTO et de l'AGARD sont également en vente auprès des agences de vente indiquées ci-dessous.

Les demandes de documents RTO ou AGARD doivent comporter la dénomination « RTO » ou « AGARD » selon le cas, suivi du numéro de série. Des informations analogues, telles que le titre est la date de publication sont souhaitables.

Si vous souhaitez recevoir une notification électronique de la disponibilité des rapports de la RTO au fur et à mesure de leur publication, vous pouvez consulter notre site Web (www.rto.nato.int) et vous abonner à ce service.

CENTRES DE DIFFUSION NATIONAUX

ALLEMAGNE
Streitkräfteamt / Abteilung III
Fachinformationszentrum der Bundeswehr (FIZBw)
Gorch-Fock-Straße 7, D-53229 Bonn

BELGIQUE
Royal High Institute for Defence – KHID/IRSD/RHID
Management of Scientific & Technological Research for Defence, National RTO Coordinator
Royal Military Academy – Campus Renaissance
Renaissancelaan 30, 1000 Bruxelles

CANADA
DSIGRD2 – Bibliothécaire des ressources du savoir
R et D pour la défense Canada
Ministère de la Défense nationale
305, rue Rideau, 9e étage
Ottawa, Ontario K1A 0K2

DANEMARK
Danish Acquisition and Logistics Organization (DALO)
Lautrupbjerg 1-5, 2750 Ballerup

ESPAGNE
SDG TECIN / DGAM
C/ Arturo Soria 289
Madrid 28033

ESTONIE
Estonian Ministry of Defence
Estonian National Coordinator for NATO RTO
Sakala 1, Tallinn 15094

ETATS-UNIS
NASA Center for AeroSpace Information (CASI)
7115 Standard Drive
Hanover, MD 21076-1320

FRANCE
O.N.E.R.A. (ISP)
29, Avenue de la Division Leclerc
BP 72, 92322 Châtillon Cedex

GRECE (Correspondant)
Defence Industry & Research General Directorate, Research Directorate
Fakinos Base Camp, S.T.G. 1020
Holargos, Athens

HONGRIE
Hungarian Ministry of Defence
Development and Logistics Agency
P.O.B. 25, H-1885 Budapest

ITALIE
General Secretariat of Defence and National Armaments Directorate
5th Department – Technological Research
Via XX Settembre 123, 00187 Roma

LUXEMBOURG
Voir Belgique

NORVEGE
Norwegian Defence Research Establishment, Attn: Biblioteket
P.O. Box 25
NO-2007 Kjeller

PAYS-BAS
Royal Netherlands Military Academy Library
P.O. Box 90.002
4800 PA Breda

POLOGNE
Centralna Biblioteka Wojskowa
ul. Ostrobramska 109
04-041 Warszawa

PORTUGAL
Estado Maior da Força Aérea
SDFA – Centro de Documentação
Alfragide, P-2720 Amadora

REPUBLIQUE TCHEQUE
LOM PRAHA s. p.
o. z. VTÚLaPVO
Mladoboleslavská 944
PO Box 18
197 21 Praha 9

ROUMANIE
Romanian National Distribution Centre
Armaments Department
9-11, Drumul Taberei Street
Sector 6
061353, Bucharest

ROYAUME-UNI
Dstl Knowledge and Information Services
Building 247
Porton Down
Salisbury SP4 0JQ

SLOVAQUIE
Akadémia ozbrojených síl gen.
M.R. Štefánika, Distribučné a informačné stredisko RTO
Demänová 393, Liptovský Mikuláš 6
031 06

SLOVENIE
Ministry of Defence
Central Registry for EU and NATO
Vojkova 55
1000 Ljubljana

TURQUIE
Milli Savunma Bakanlığı (MSB)
ARGE ve Teknoloji Dairesi Başkanlığı
06650 Bakanliklar
Ankara

AGENCES DE VENTE

NASA Center for AeroSpace Information (CASI)
7115 Standard Drive
Hanover, MD 21076-1320
ETATS-UNIS

The British Library Document Supply Centre
Boston Spa, Wetherby
West Yorkshire LS23 7BQ
ROYAUME-UNI

Canada Institute for Scientific and Technical Information (CISTI)
National Research Council Acquisitions
Montreal Road, Building M-55
Ottawa K1A 0S2, CANADA

Les demandes de documents RTO ou AGARD doivent comporter la dénomination « RTO » ou « AGARD » selon le cas, suivie du numéro de série (par exemple AGARD-AG-315). Des informations analogues, telles que le titre et la date de publication sont souhaitables. Des références bibliographiques complètes ainsi que des résumés des publications RTO et AGARD figurent dans les journaux suivants :

Scientific and Technical Aerospace Reports (STAR)
STAR peut être consulté en ligne au localisateur de ressources uniformes (URL) suivant: http://ntrs.nasa.gov/search.jsp
STAR est édité par CASI dans le cadre du programme NASA d'information scientifique et technique (STI)
NASA Langley Research Center, STI Program Office, MS 157A
Hampton, Virginia 23681-0001
ETATS-UNIS

Government Reports Announcements & Index (GRA&I)
publié par le National Technical Information Service
Springfield
Virginia 2216
ETATS-UNIS
(accessible également en mode interactif dans la base de données bibliographiques en ligne du NTIS, et sur CD-ROM)

NORTH ATLANTIC TREATY ORGANISATION

RESEARCH AND TECHNOLOGY ORGANISATION

BP 25

F-92201 NEUILLY-SUR-SEINE CEDEX • FRANCE

Télécopie 0(1)55.61.22.99 • E-mail mailbox@rta.nato.int

DISTRIBUTION OF UNCLASSIFIED RTO PUBLICATIONS

AGARD & RTO publications are sometimes available from the National Distribution Centres listed below. If you wish to receive all RTO reports, or just those relating to one or more specific RTO Panels, they may be willing to include you (or your Organisation) in their distribution.

RTO and AGARD reports may also be purchased from the Sales Agencies listed below.

Requests for RTO or AGARD documents should include the word 'RTO' or 'AGARD', as appropriate, followed by the serial number. Collateral information such as title and publication date is desirable.

If you wish to receive electronic notification of RTO reports as they are published, please visit our website (www.rto.nato.int) from where you can register for this service.

NATIONAL DISTRIBUTION CENTRES

BELGIUM
Royal High Institute for Defence – KHID/IRSD/RHID
Management of Scientific & Technological Research for Defence, National RTO Coordinator
Royal Military Academy – Campus Renaissance
Renaissancelaan 30
1000 Brussels

CANADA
DRDKIM2 – Knowledge Resources Librarian
Defence R&D Canada
Department of National Defence
305 Rideau Street, 9th Floor
Ottawa, Ontario K1A 0K2

CZECH REPUBLIC
LOM PRAHA s. p.
o. z. VTÚLaPVO
Mladoboleslavská 944
PO Box 18
197 21 Praha 9

DENMARK
Danish Acquisition and Logistics Organization (DALO)
Lautrupbjerg 1-5
2750 Ballerup

ESTONIA
Estonian Ministry of Defence
Estonian National Coordinator for NATO RTO
Sakala 1, Tallinn 15094

FRANCE
O.N.E.R.A. (ISP)
29, Avenue de la Division Leclerc
BP 72, 92322 Châtillon Cedex

GERMANY
Streitkräfteamt / Abteilung III
Fachinformationszentrum der Bundeswehr (FIZBw)
Gorch-Fock-Straße 7
D-53229 Bonn

GREECE (Point of Contact)
Defence Industry & Research General Directorate, Research Directorate
Fakinos Base Camp, S.T.G. 1020
Holargos, Athens

HUNGARY
Hungarian Ministry of Defence
Development and Logistics Agency
P.O.B. 25, H-1885 Budapest

ITALY
General Secretariat of Defence and National Armaments Directorate
5th Department – Technological Research
Via XX Settembre 123, 00187 Roma

LUXEMBOURG
See Belgium

NETHERLANDS
Royal Netherlands Military Academy Library
P.O. Box 90.002
4800 PA Breda

NORWAY
Norwegian Defence Research Establishment, Attn: Biblioteket
P.O. Box 25
NO-2007 Kjeller

POLAND
Centralna Biblioteka Wojskowa
ul. Ostrobramska 109
04-041 Warszawa

PORTUGAL
Estado Maior da Força Aérea
SDFA – Centro de Documentação
Alfragide, P-2720 Amadora

ROMANIA
Romanian National Distribution Centre
Armaments Department
9-11, Drumul Taberei Street
Sector 6, 061353, Bucharest

SLOVAKIA
Akadémia ozbrojených síl gen.
M.R. Štefánika, Distribučné a informačné stredisko RTO
Demänová 393, Liptovský Mikuláš 6
031 06

SLOVENIA
Ministry of Defence
Central Registry for EU & NATO
Vojkova 55
1000 Ljubljana

SPAIN
SDG TECIN / DGAM
C/ Arturo Soria 289
Madrid 28033

TURKEY
Milli Savunma Bakanlığı (MSB)
ARGE ve Teknoloji Dairesi Başkanlığı
06650 Bakanliklar – Ankara

UNITED KINGDOM
Dstl Knowledge and Information Services
Building 247
Porton Down
Salisbury SP4 0JQ

UNITED STATES
NASA Center for AeroSpace Information (CASI)
7115 Standard Drive
Hanover, MD 21076-1320

SALES AGENCIES

NASA Center for AeroSpace Information (CASI)
7115 Standard Drive
Hanover, MD 21076-1320
UNITED STATES

The British Library Document Supply Centre
Boston Spa, Wetherby
West Yorkshire LS23 7BQ
UNITED KINGDOM

Canada Institute for Scientific and Technical Information (CISTI)
National Research Council Acquisitions
Montreal Road, Building M-55
Ottawa K1A 0S2, CANADA

Requests for RTO or AGARD documents should include the word 'RTO' or 'AGARD', as appropriate, followed by the serial number (for example AGARD-AG-315). Collateral information such as title and publication date is desirable. Full bibliographical references and abstracts of RTO and AGARD publications are given in the following journals:

Scientific and Technical Aerospace Reports (STAR)
STAR is available on-line at the following uniform resource locator: http://ntrs.nasa.gov/search.jsp
STAR is published by CASI for the NASA Scientific and Technical Information (STI) Program
NASA Langley Research Center, STI Program Office, MS 157A
Hampton, Virginia 23681-0001
UNITED STATES

Government Reports Announcements & Index (GRA&I)
published by the National Technical Information Service
Springfield
Virginia 2216
UNITED STATES
(also available online in the NTIS Bibliographic Database or on CD-ROM)

ISBN 978-92-837-0161-3